4- RESULTS AND DISCUSSION

4-1- Effect of gamma irradiation and cold storage on the chemical composition of Chicken meat and Fish flesh (carp)

The effects of gamma irradiation and cold storage (5 ± 1 °C) on moisture, protein, fat, ash, total carbohydrates contents and some chemical indicates for spoilage i e pH value, total volatile bases nitrogen (T.V.B.N) and thiobarbituric acid (T.B. A) are presented in Tables (1 - 16).

1- Moisture content of Chicken meat and Fish flesh :

From data in Tables (1 and 2) it could be noticed that the moisture contents were 72.28 and 74. 57% of chicken meat and fish flesh respectively.These results are in agreement with those obtained by *Abo-Zeid (1995); El - Hanafy (1997); and Shawki (1998)*.The same results indicated that gamma irradiation and cold storage at (5 ± 1 °C) treatments had no real effects on the moisture content of chicken and fish which was 72.28 in control sample for chicken while was 72.29, 72.14, 72.02 and 71.87 / for irradiated samples at doses 2.5, 5, 7.5 and 10 KGY respectively; meanwhile the moisture content of fish was 74.57 in control samples and was 74.49, 74.3, 74.04 and 73.82 % for samples exposed to 2.5, 5, 7.5 and 10 KGY gamma irradiation doses, respetrvely

Regarding to the cold storage of irradiated samples the moisture content of control and irradiated samples were slightly decreased with storage time increased for both chicken and fish samples. This decrease in the moisture content during cold storage may be attributed to the decrease in water - holding capacity and loss

Table (1): Effect of gamma irradiation on *moisture* content of chicken meat during cold storage.

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	72.38	0.000	72.29	0.000	72.14	0.000	72.02	0.000	71.87	0.000
7	71.89	-0.676	72.08	-0.290	71.93	-0.291	71.82	-0.277	71.76	-0.153
14	71.39	-1.367	71.75	-0.746	71.68	-0.637	71.61	-0.569	71.61	-0.361
21	---		71.28	-1.397	71.41	-1.011	71.40	-0.860	71.45	-0.584
28	---	---	---	---	71.11	-1.427	71.19	-1.152	71.29	-0.807
35	---	---	---	---	---	---	70.99	-1.430	71.14	-1.015
42	---	---	---	---	---	---	---	---	70.97	-1.252
49	---	---	---	---	---	---	---	---	70.82	-1.406
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (2): Effect of gamma irradiation on moisture content of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	74.57	0.000	74.49	0.000	74.30	0.000	74.04	0.000	73.82	0.000
7	73.06	-2.024	73.92	-0.765	73.95	-0.471	73.78	-0.351	73.67	-0.203
14	---	---	72.93	-2.094	73.32	-1.318	73.24	-1.080	73.32	-0.677
21	---	---	---	---	72.81	-2.005	72.69	-1.823	73.17	-0.880
28	---	---	---	---	---	---	---	---	72.82	-1.354
35	---	---	---	---	---	---	---	---	72.57	-1.693
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

of small drip. ***Khallaf (1982); Hammad (1985) ; Shawki (1998); and Afifi and El-Nashaby (2001).***

2- Protein content of Chicken meat and Fish flesh:

Data presented in Tables (3 and 4) show the effect of gamma irradiation on protein content of chicken and fish during storage at 5 ±1°C . It is obvious from these results that the applied doses of gamma irradiation had no remarkabe effects on the protein content of chicken and fish samples, since the protein contents were 80.68, 80.47, 80. 2, 80.00 and 79.85 % for chicken while were 79.78, 79.69, 79,58, 79,52 and 79,41 % for fish which exposed to, 0. 2.5, 5, 7.5 and 10 KGY gamma irradiation doses respectively.

The same Tables indicate also that the protein content of samples undertaken showed a slight decrease during cold storage which decreased from 80. 68% in content sample to 79.69 % after 14 days storage at 5 ±1°C for chicken while decreased from 79.78 to 78.90 in control samples of fish stored at 5 ± 1°C after 7 days, These effects might be due to the bacterial decomposition and escaping of some soluble nitrogen compounds within the separated fluid. Similar results were reported by ***Ibrahim (1980); Hammad (1985); Shawki (1998); and Afifi and El-Nashaby (2001).***

3- Fat content of Chicken meat and Fish Flesh:

Tables (5 and 6) indicates that no detectable differences in the fat content between the untreated and irradiated samples for both chicken and fish, which the fat content of chicken samples was 15.7,15.68, 15.66, 15.61 and 15.52% for samples treated with 0, 2.5, 5.0, 7.5 and 10 KGY gamma irradiation doses respectively. Also, it is obvious from the same Tables that cold storage at 5 ±1 had no

Table (3): Effect of gamma irradiation on the total protein content of chicken, meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	80.68	0.000	80.47	0.000	80.20	0.000	80.00	0.000	79.85	0.000
7	80.18	-0.619	80.16	-0.385	80.00	-0.249	79.97	-0.037	79.74	-0.137
14	79.69	-1.227	79.68	-0.981	79.70	-0.610	79.86	-0.175	79.65	-0.250
21	---	---	79.57	-1.118	79.68	-0.648	97.69	-0.387	79.52	-0.388
28	---	---	---	---	79.49	-0.885	79.45	-0.687	79.50	-0.438
35	---	---	---	---	---	---	79.34	-0.825	79.46	-0.488
42	---	---	---	---	---	---	---	---	79.45	-0.500
49	---	---	---	---	---	---	---	---	79.43	-0.525
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (4): Effect of gamma irradiation on the total protein content of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	79.78	0.000	79.69	0.000	79.58	0.000	79.52	0.000	79.41	0.000
7	78.96	-1.027	79.51	-0.225	79.47	-0.138	79.49	-0.037	79.38	-0.037
14	---	---	79.11	-0.727	79.35	-0.289	79.29	-0.289	79.30	-0.138
21	---	---	---	---	79.22	-0.452	79.01	-0.641	79.27	-0.176
28	---	---	---	---	---	---	---	---	79.18	-0.289
35	---	---	---	---	---	---	---	---	79.00	-0.516
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (5): Effect of gamma irradiation on the fat content of chicken meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	15.70	0.000	15.68	0.000	15.66	0.000	15.61	0.000	15.52	0.000
7	15.69	-0.063	15.68	0.000	15.64	-0.127	15.58	-0.192	15.51	-0.064
14	15.60	-0.636	15.61	-0.446	15.61	-0.319	15.51	-0.640	15.48	-0.257
21	---	---	15.60	-0.501	15.60	-0.383	15.47	-0.896	15.46	-0.386
28	---	---	---	---	15.58	-0.510	15.45	-1.024	15.47	-0.322
35	---	---	---	---	---	---	15.48	-0.832	15.47	-0.322
42	---	---	---	---	---	---	---	---	15.46	-0.386
49	---	---	---	---	---	---	---	---	15.45	-0.451
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (6): Effect of gamma irradiation on the fat content of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	15.99	0.000	16.00	0.000	16.09	0.000	16.03	0.000	15.97	0.000
7	15.90	-0.562	15.95	-0.312	15.88	-1.305	15.79	-1.497	15.96	-0.062
14	---	---	15.87	-0.812	15.82	-1.678	15.78	-1.559	15.89	-0.500
21	---	---	---	---	15.70	-2.423	15.66	-2.308	15.85	-0.751
28	---	---	---	---	---	---	---	---	15.85	-0.751
35	---	---	---	---	---	---	---	---	15.79	-1.127
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

noticalele effects on the fat content of chicken and fish samples neither untreated nor treated samples with gamma irradiation, as the fat content reached 15.6, 15.6, 15.58, 15,48 and 15,45 and 15.9, 15.87, 15.70, 15.66 and 15.79 %. For chicken and fish samples under investigation respectively. This results were in agreement with those obtained by ***Hammad (1985); El-Mongy (1990); Showki (1998); and Afifi and El-Nashaby (2001).***

4- Ash content of Chicken meat and Fish flesh:

From data in Tables (7 and 8) it could be noticed that the ash contents were 3.11 and 3.75 % for chicken and fish respectively. These results are in agreement with those obtained by ***El- Mongy (1990);El-Hanafy (1997); and Shawki (1998).***

The same results indicated that gamma irradiation and cold storage at 5 ± 1 °C had no effect on the ash content of chicken meat and fish flesh which was 3.11 in control sample for chicken, while was 3.16, 315, 3.20 and 3.14 % for irradiated samples at doses 2.5, 5.0, 7.5 and 10 KGY respectively, meanwhile the ash content of fish flesh was 3.76, 3.76, 3.77 and 3.75% for samples exposed to 2.5, 5.0, 7.5 and 10.0 KGY gamma irradiation doses, respectively.

Regarding to cold storage of irradiated samples the ash content of chicken and fish samples there were no significant changes due to either unirradiation or / irradiation (2.5, 5.0, 7.5 and 10.0 KGY) of samples during storage at 5 ± 1 °C until signs of spoilage appeared.This is in agreement with, ***Afifi and El-Nashaby (2001).***

5- Carbohydrate content of Chicken meat and Fish flesh:

Data presents in Tables (9 and 10) showed the that effect of gamma irradiation on carbohydrate content of chicken meat and fish

Table (7): Effect of gamma irradiation on the ash content of chicken meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	ash %	variation %	ash %	variation %	ash %	variation %	ash %	variation %	ash %	variation %
0	3.11	0.000	3.16	0.000	3.15	0.000	3.20	0.000	3.14	0.000
7	3.14	0.964	3.16	0.000	3.16	0.317	3.20	0.000	3.14	0.000
14	3.10	-0.321	3.15	-0.316	3.15	0.000	3.21	0.312	3.15	0.318
21	---	---	3.16	0.000	3.14	-0.317	3.19	-0.312	3.13	-0.318
28	---	---	---	---	3.16	0.317	3.20	0.000	3.14	0.000
35	---	---	---	---	---	---	3.19	-0.312	3.14	0.000
42	---	---	---	---	---	---	---	---	3.15	0.318
49	---	---	---	---	---	---	---	---	3.14	0.318
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (8): Effect of gamma irradiation on the ash content of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	ash %	variation %	ash %	variation %	ash %	variation %	ash %	variation %	ash %	variation %
0	3.75	0.000	3.76	0.000	3.76	0.000	3.77	0.000	3.75	0.000
7	3.75	0.000	3.75	-0.265	3.77	0.265	3.77	0.000	3.74	-0.266
14	---	---	3.76	0.000	3.75	-0.265	3.78	0.265	3.75	0.000
21	---	---	---	---	3.77	0.265	3.76	-0.265	3.76	0.266
28	---	---	---	---	---	---	---	---	3.76	0.266
35	---	---	---	---	---	---	---	---	3.74	-0.266
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (9): Effect of gamma irradiation on the carbohydrate(carb.) content of chicken meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	carb. %	Increase	carb. %	Increase	carb. %	Increase	carb. %	Increase	carb. %	Increase
0	0.51	0.000	0.69	0.000	0.99	0.000	1.19	0.000	1.49	0.000
7	0.98	92.156	1.00	44.927	1.20	21.212	1.25	5.042	1.61	8.053
14	1.47	188.235	1.55	124.637	1.53	54.545	1.42	19.327	1.72	15.436
21	---	---	1.67	142.028	1.58	59.595	1.65	38.655	1.87	25.503
28	---	---	---	---	1.77	78.787	1.90	59.663	1.89	26.845
35	---	---	---	---	---	---	1.99	69.226	1.93	29.530
42	---	---	---	---	---	---	---	---	1.94	30.201
49	---	---	---	---	---	---	---	---	1.98	32.885
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (10): Effect of gamma irradiation on the carbohydrate(carb.) content of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	carb. %	Increase	carb. %	Increase	carb. %	Increase	carb. %	Increase	carb. %	Increase
0	0.48	0.000	0.55	0.000	0.57	0.000	0.68	0.000	0.87	0.000
7	1.39	189.583	0.79	43.636	0.88	54.385	0.95	39.705	0.92	5.747
14	---	---	1.26	129.090	1.08	89.473	1.15	69.117	1.06	21.839
21	---	---	---	---	1.31	129.824	1.57	130.882	1.12	28.735
28	---	---	---	---	---	---	---	---	1.21	39.080
35	---	---	---	---	---	---	---	---	1.47	68.965
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

flesh during cold storage at 5 ± 1 °C, were obvious from these results that the applied doses of gamma irradiation had no remarkable effects on the carbohydrate content of chicken meat and fish flesh samples, since the carbohydrate contents were 0.48, 0.55, 0.57, 0.68 and 0.87% for fish flesh while were 0.51. 0.69, 0.99, 1.19 and 1.49% for chicken meat exposed to 0.0, 2.5, 5.0, 7.5 and 10.0 KGY gamma irradiation doses respectively.

The same tables indicates also that the carbohydrate content of all samples under study showed slight increase during cold storage which increased from o.51% in control samples to 1.47 %. After 14 days storage at 5 ± 1 °C for chicken meat while increased from 0.48% to 1.39% in control samples of fish flesh stored at 5 ± 1 °C after 7 days, these effects might be due the natural feeding which resulted increase of glycogen in muscles or may be due to evaporation of water from the outer surface of meat. Similar results was reported by ***El - Shamary (1988); and Afifi and El - Nashaby (2001).***

6- Total Volatile Basis Nitrogen (T.V.B.N) of Chicken meat and Fish flesh:

The Total volatile Basis Nitrogen (T.V.*B. N)* is commonly used to determined the freshness of meat. Data present in tables (11and 12) showed that the T.V.B.N of control chicken meat and fish flesh samples were 12.56 and 9.86 mg N/100 gm sample respectively. Meanwhile, the same data indicate a slight increase in the T.V.B.N of chicken meat and fish flesh directly post irradiation, since, T.V.B.N increase from 12.56 in control sample to 12.66, 12.77, 13,39 and 15 mg N / 100 g by exposing chicken meat to gamma irradiation at doses 2.5, 5.0, 7.5 and 10 KGY respectively while the T.V.B.N of fish flesh increased from 9.86 in control samples to 9.79, 9.98, 10.75 and 11.84

Table (11): Effect of gamma irradiation on the total volatile basis nitrogen (T.V.B.N) of chicken meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %
0	12.56	0.000	12.66	0.000	12.77	0.000	13.39	0.000	15.00	0.000
7	15.64	24.522	14.35	13.349	13.98	9.475	14.11	5.377	15.38	2.533
14	19.87	58.200	16.04	26.698	15.38	20.438	14.92	11.426	15.78	5.200
21	---	---	18.73	47.946	16.69	30.696	15.69	17.176	16.16	7.733
28	---	---	---	---	18.80	47.220	16.46	22.927	16.54	10.266
35	---	---	---	---	---	---	18.23	36.146	16.86	12.400
42	---	---	---	---	---	---	---	---	17.32	15.466
49	---	---	---	---	---	---	---	---	18.70	24.666
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (12): Effect of gamma irradiation on the total volatile basis nitrogen (T.V.B.N) of fish flesh during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %
0	9.86	0.000	9.79	0.000	9.98	0.000	10.75	0.000	11.84	0.000
7	14.47	46.754	11.61	18.590	11.32	13.426	11.41	6.139	12.11	2.280
14	---	---	13.63	39.223	12.75	27.755	12.32	14.604	12.24	3.378
21	---	---	---	---	14.29	43.186	13.45	25.116	12.67	7.010
28	---	---	---	---	---	---	---	---	13.05	10.219
35	---	---	---	---	---	---	---	---	13.36	12.837
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

mg N/100g sample by exposing fish flesh to the same doses of gamma irradiation. This might be due to the direct effect of irradiation on some free amino acids leading to the formation of a small amount of ammonia ***khallaf (1982); and Showki (1998); and Afifi and El-Nashaby (2001).***

During storage, the amount of T.V.B.N continuously increased in all samples undertaken but the unirradiated samples recorded the higher values than that of irradiation ones. The T.V..N of the control samples reached to 19.87 and 14.47 mg N/100 g sample of chicken meat and fish flesh at the end of their storage period (14 and 7 days) respectively. Meanwhile The T.V.B.N of irradiated samples chicken and fish exposed to 2.5, 5, 7.5 and 10 KGY reached to 18.73, 18.8, 18.23 and 18.70 mg N/100 g samples of chicken meat and reached to 13.63, 14.29, 13.45 and 13.36 mg N/100 g samples of fish flesh at the end of their storage period at 5 ± 1 ºC for 21, 28, 35 and 49 days and was 14, 21, 21, and 35 for irradiated chicken meat and fish flest respectively.

Regarding irradiated samples, it is obvious from the results that the rate of increase in the T.V.B.N was lower at higher dose than at the lower one. This could be due to the reactivity of some microorganisms which are not completely destroyed by low doses and / or to the break down of some proteins and anino acids leading to the information of ammonia and trimathylamine as reported by ***Venugopal et al.,(1987);Pool, et al., (1996); Al-Kahtani, et al., (1996); and Afifi and El-Nashaby (2001)***

7- Thiobarbitutric acid (T.B.A) of Chicken meat and fish flesh:

Thiobarbitutric acid value was use to measure lipid oxidation as an index for fat oxidation and to determined the concentration of some oxidation products as malonaldehyde which is always found in fat exposed to oxidative deterioration. *T.B. A* also which are considered as spoilage indicators in conjunction with the microbiological and organolepric properties were determined in chicke and fish samples before and after irradiation and throughout the storage period (Tables 13 and 14) obviously, of control chicken and fish samples were 0.062 and 0.124 mg / 100 g at zero time of storage period respectively mean while, this value showed a gradual increase with increasing gamma irradiation dose as it increase from o.o62 Mg / 100 g in control samples to o.101, 0.139, 0.178 and 0.196 mg / 100 g. After exposed chicken samples to 2.5, 5.0, 7.5 and 10.0 KGY gamma irradiation dose respectively as well as it increase from 0.124 mg / 100 g in control samples to 0.145, 0.171, 0.184 and 0.203 mg / 100 g after exposed fish samples to 2.5, 5.0, 7.5 and 10.0 KGY gamma irradiation dose respectively. This slight increase in T.B.A value which may be attributed to effect of radiation doses applied in enhancing oxidation of chicken and fish lipids the same observations were also noticed by ***khallaf (1982); El- Mongy (1990); and Shawki (1998).***

The T.B.A values were also followed (increasing) during storage, in the control chicken and fish samples with unirradiated and irradiated chicken and fish samples at different dose levels stored at 5 ± 1 °C especially with higher doses treated samples which lasted for few weeks of storage this exhibited of slighit increases in their T.B.N values during cold storage to be due to that malonaldehyde precursors

Table (13): Effect of gamma irradiation on the thiobarbituric acid value (T.B.A) of chicken meat during cold storage

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %
0	0.062	0.000	0.101	0.000	0.139	0.000	0.178	0.000	0.196	0.000
7	0.230	270.967	0.155	53.465	0.199	43.165	0.218	22.471	0.232	18.367
14	0.381	514.516	0.256	153.465	0.239	71.942	0.238	33.707	0.262	33.673
21	---	---	0.330	226.732	0.309	122.302	0.298	67.415	0.301	53.571
28	---	---	---	---	0.352	153.237	0.338	89.887	0.342	74.489
35	---	---	---	---	---	---	0.374	110.112	0.374	90.816
42	---	---	---	---	---	---	---	---	0.420	114.285
49	---	---	---	---	---	---	---	---	0.434	121.428
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (14): Effect of gamma irradiation on the thiobarbituric acid value (T.B.A) of fish flesh during cold storage.

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %
0	0.124	0.000	0.145	0.000	0.171	0.000	0.184	0.000	0.203	0.000
7	0.371	199.193	0.213	46.896	0.220	28.654	0.244	32.608	0.218	7.389
14	---	---	0.382	163.448	0.303	77.192	0.321	74.456	0.261	28.571
21	---	---	---	---	0.391	128.654	0.398	116.304	0.311	53.201
28	---	---	---	---	---	---	---	---	0.387	90.640
35	---	---	---	---	---	---	---	---	0.436	114.778
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

accumulate as a stable end product. The obtained results are in full agreement with those of ***Yousef (1987); Hagazy (1987); El-Mongy (1990); Hoda (1994); Kraima (1997); and Showki (1998).***

However T.B.A values of all irradiated and unirradiated samples at any given time of cold storage were within the safe margin above which off flavour and off - odours in meat tissues could be noticed ***(El- Mongy 1990)*** these results also indicated that vacuum packaging was effective in minimizing lipid oxidation ***Jantavat and Dawson (1980); and Simard et al., (1983).***

8- pH value of Chicken meat and Fish flesh:

Data presented in tables (15 and 16) represent the PH value of the chicken and fish either untreated (Control) or treated with various doses of gamma irradiation. it could be noticed that the PH value of the control chicken samples was about 6.31 at Zero time of cold storage. While the pH values of irradiated chicken samples were 6.21, 6,,16, 6,10 and 6,00 for samples treated with 2.5, 5.0, 7.5 and 10.0 KGY respectively.

Also, the pH value of control fish flesh samples was about 5.87 at zero time of cold storage as well as the pH values of irradiated fish samples were 5.76, 5.71, 5.68 and 5.59 for samples treated with 2.5, 5.0, 7.5 and 10.0 KGY respectively. Generally, no - significant differences were observed between all treatments at the beginning of storage. However, during storage the PH value was slightly decreased for all treatments under investigation and reached 5.81 and 5.24 for control of chicken meat and fish flesh samples at the end of storage being 14 and 7 days, respectively. Meanwhile the PH value of irradiated chicken meat and fish flesh samples showed also a slight

Table (15): Effect of gamma irradiation on the pH value content of chicken meat during cold storage.

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %
0	6.31	0.000	6.21	0.000	6.16	0.000	6.10	0.000	6.00	0.000
7	6.07	-3.803	6.04	-2.737	6.07	-1.461	6.04	-0.983	5.95	-0.833
14	5.81	-7.923	5.87	-5.475	5.98	-2.922	5.98	-1.967	5.90	-1.666
21	---	---	5.70	-8.212	5.89	-4.383	5.92	-2.950	5.88	-2.000
28	---	---	---	---	5.80	-5.844	5.86	-3.934	5.81	-3.166
35	---	---	---	---	---	---	5.80	-4.918	5.77	-3.833
42	---	---	---	---	---	---	---	---	5.76	-4.000
49	---	---	---	---	---	---	---	---	5.68	-5.333
56	---	---	---	---	---	---	---	---	---	---

--- = No analysis

Table (16): Effect of gamma irradiation on the pH value content of fish flesh during cold storage.

Storage Period (In days)	Dose (KGY)									
	0.0		2.5		5.0		7.5		10.0	
	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %
0	5.87	0.000	5.76	0.000	5.71	0.000	5.68	0.000	5.59	0.000
7	5.24	-10.732	5.49	-4.687	5.56	-2.626	5.56	-2.112	5.52	-1.252
14	---	---	5.23	-9.201	5.42	-5.078	5.44	-4.225	5.45	-2.504
21	---	---	---	---	5.27	-7.705	5.29	-6.866	5.36	-4.114
28	---	---	---	---	---	---	---	---	5.29	-5.366
35	---	---	---	---	---	---	---	---	5.22	-6.618
42	---	---	---	---	---	---	---	---	---	---

--- = No analysis

decrease and reached to 5.7, 5.8, 5.8 and 5.68 after cold storage for 21, 28, 35 and 49 days of irradiated chicken samples with 2.5, 5.0,7.5 and 10 KGY respectively. As well as reached to 5,23, 5,27, 5,29 and 5.22 after cold storage for 14, 21, 21, and 35 days of irradiated fish samples with, 2.5, 5.0, 7.5 and 10 KGY respectively. These fall in pH may be due to the microbial activity and/or the dissolution of Co_2 into meat tissue as reported by ***khallaf (1982); Simard et al., (1983); Shaltout (1989); El- Mongy (1990); Hoda (1994); Khallaf (1996); and Shawki (1998).***

4-2- Effect of gamma irradiation and cold storage on The microbial aspects of Chicken meat

(1) Total Aerobic bacterial count of Chicken meat:

The quality of chicken meat are largely dependent on their microbial contamination, there fore, any technological treatment can be effectively used to eliminate or destroy the pathogenic micro-organisms is very required processing for improving the hygienic quality of the final product. Irradiation was found to be the only processing technique which is likely to overcome food poisoning from chicken ***B. M.A (1989).***

The results in table (17) show that the initial aerobic bacterial count of control chicken meat at zero time and before cold storage was 6.5×10^4 c. f. u / g this value is within the range of values of fresh chicken as reported by ***Hegazy (1987); El-Mongy (1990); Hoda (1994); and Kraima (1997).***

The table indicates also that, a gradual increase in the total bacterial count of the control chicken meat sample was observed

Table (17): Effect of gamma irradiation on total of aerobic bacterial count of Chicken meat during cold storage.

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	6.5×10^4	4.812	1.2×10^3	3.079	2.8×10^2	2.447	7.8×10	1.892	1.3×10	1.113
7	9.6×10^5	5.982	3.1×10^3	3.491	9.0×10^2	2.954	6.0×10^2	2.778	7.2×10	1.857
14	8.5×10^6	6.929	1.1×10^5	5.041	7.1×10^3	3.851	4.2×10^3	3.623	3.0×10^2	2.477
21	---	---	2.0×10^6	6.301	8.2×10^4	4.913	3.5×10^4	4.544	1.7×10^3	3.230
28	---	---	---	---	1.6×10^6	6.204	1.7×10^5	5.230	1.4×10^4	4.146
35	---	---	---	---	---	---	1.4×10^6	6.146	9.9×10^4	4.995
42	---	---	---	---	---	---	---	---	8.9×10^5	5.949
49	---	---	---	---	---	---	---	---	4.0×10^6	6.602
56	---	---	---	---	---	---	---	---	---	---

--- = No count

during cold storage and reached to 8.5 x 10^{6} c.f.u /g after 2 weeks of cold storage. At this stage, the control chicken samples were completely rejected by the border line of chicken acceptability for total microbial counts was found to be ($\geq 10^{6}$) cell / g and appearance of putrid smell as reported by

El- Mongy (1990). This increasing in the total bacterial count was expected as the chicken meat is considered one of the most perishable food that is highly susceptible to microbial in vasion.

Application of gamma irradiation led to great reduction in the microorganisms of treated chicken samples. Immediately after the radiation process. The total bacterial count decreased from 6.5 x 10^{4} c.f.u /g in the control chicken sample to 1.2 x $10^{3,}$ 2.8 x $10^{2,}$ 7.8 x 10 and 1.3 x 10 c.f.u / g. after exposing chicken samples to 2.5, 5.0, 7.5 and 10 KGY respectively in other words it is means the reduction percentages were 98.15, 99.56, 99.88 and 99.98 % for the above mentioned doses comparing with the control chicken sample. The greatest reduction in the bacterial load is mainly due to the direct and indirect effects of gamma irradiation on the microorganisms agree with ***Youssef (1981); El - Mongy (1990); Hoda (994); and Kraima (1997)***

During subsequent cold storage at 5 ± 1 °C, the bacterial count of unirradiated and irradiated chicken samples had increased with storage time increasing, but with different rates. The higher, the irradiation dose, the lower was the rate of increase this might be due to that post - irradiation flora were less metabolically active under these conditions

El- Mongy (1990). However the data of Table (17) show that the total bacterial count of irradiated chicken samples at 2.5, 5.0, 7.5 and 10.0 kGy were rejected after 3,4,5 and 7 weeks respectively where the total bacterial count reached to $2.0x10^6$, $1.6 x10^6$, $1.4x10^6$ and $4.0x10^6$ c.f.u / g for the ascending doses respectively. Indicating the importance of irradiation in extending the shelf-life of refrigerated chicken meat, these results emphasized the finding of ***youssef (1981); khallaf (1982); El-Mongy (1990); Chen et al., (1996);Owczarczk et al., (1999); and Afifi and El-Nashaby (2001).***

It could be concluded that the shelf - life of refrigerated chicken extanded to more than 2 weeks by irradiation an extension to 3,4,5 and 7 weeks were reached when irradiation dose of 2.5, 5.0, 7.5 and 10.0 kGy respectively, were used.

In addition that the total bacterial count of chicken meat was loweist levels at dose (10.0kGy) compared, with other samples during cold storage extended it's the shelf - life by four times as compared with the unirradiated samples.

(2) Total Anaerobic bacterial count of Chicken meat:

Data in table (18) show that the count of Anaerobic organisms of control chicken was $1.1x10^3$ c.f.u /g at zero time and continuously increase during cold storage period to $8.2x10^4$ c.f.u /g. after 2 weeks and it was rejected at this stage The rejection of samples after two weeks depended up on total aerobic bacterial count reached to ($\geq 10^6$) and appearance of putrid smell as reported by ***El-Mongy (1990); and, Shawki (1998).***

Inaddition, it could be noticed that the treat ment with gamma irradiation before storage reduced the count of anaerobic organisms

Table (18): Effect of gamma irradiation on total anaerobic bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1×10^3	3.041	1.0×10^2	2.000	3.3×10	1.518	8.0	0.903	Nil	Nil
7	6.1×10^3	3.785	7.0×10^2	2.845	1.8×10^2	2.255	4.0×10	1.602	Nil	Nil
14	8.2×10^4	4.913	3.2×10^3	3.505	4.0×10^2	2.602	1.1×10^2	2.000	Nil	Nil
21	---	---	2.5×10^4	4.397	2.0×10^3	3.301	3.8×10^2	2.579	Nil	Nil
28	---	---	---	---	1.4×10^4	4.146	1.7×10^3	3.230	Nil	Nil
35	---	---	---	---	---	---	1.0×10^4	4.000	Nil	Nil
42	---	---	---	---	---	---	---	---	Nil	Nil
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count

Nil=No viable count

from $1.1x10^3$ c.f.u/g for the control chicken sample to $1.0x10^2$, 3.3x10 and 8.0 c.f.u/g after exposing chicken samples to 2.5, 5.0 and 7.5 kGy respectively. As well as from the same table and figures it could be noticed that using 10.0 kGy gamma radiation was sufficient for complete elimination of anaerobic organisms in chicken samples

Moreover the data in previous table and figs show that the total Anaerobic bacterial count gradually increased in the irradiated chicken samples by increasing the cold storage period.

However the chicken sample were rejected after 3, 4, 5 and 7 weeks, when irradiation with 2.5, 5.0, and 7.5 kGy respectively, and the total Anaerobic count of chicken samples reached to 2.5 x 10^4, 1.4 x 10^4 and 1.0 x 10^4 c.f.u/g for the ascending doses, respectively.

These finding were in agreement with those obtained by many investigator ***Youssef (1981); El- mongy (1990); Pool et al., (1996); Rady et al., (1999); and Crawford (1999).***

On the other hand, it is observable that the application of 10.0 kGy gamma irradiation dose had a greater effect on the anaerobic micribial counts compared with other unirradiated and irradiated samples during cold storage.

(3) Total yeast and Mould count of Chicken meat:

The use of gamma irradiation with a dose level of 2.5 kGy, almost inhibited the few cells of *yeasts and mould* that were present in the samples before irradiation. However, few colonis of *yeasts and mould* were appeared after one week of storage in the irradiated (2.5kGy) samples. During storage, the *yeasts and mould* counts of unirradiated and irradiated samples increased by almost the same rate after the first period of storage reaching $7.2x10^3$ and $6.5x10^2$

organisms/g at the end of the 2th and 3th week for unirradiated and irradiated samples, respectively (Table 19) these results agree with *khallafe (1982); El- Mongy (1990); Afifi and El-Nashaby (2001).*

(4) Total psychrophilic bacterial count of Chicken meat:

Data in table (20) show that irradiation at 2.5 and 5.0 kGy sharply decreased the *psychrophilic* counts,it decreased from

5.9 x 10^{3} c.f.u / g of control sample to 8.8 x 10 and 1.1 x 10 c.f.u / g for irritated sample at doses 2.5 and 5.0 KGY respectively. While no growth could be detected in samples treated by 7.5 and 10.0 kGy, respectively, this prove the high sensitivity of this group of organisms to radiation.

However, the counts of the *psychrorophilic* bacterial progressively increased during storage in samples treated with dose levels of 2.5 and 5.0 kGy, till rejected after 3 and 4 weeks, respectively.

At the higher doses the inhibited cells started to proliferate after the first week of storage in samples treated with 7.5 kGy and after 5 weeks in samples treated with 10.0 kGy, followed by gradual increased in psychrophilic count till the sample were rejected after 5 and 7 weeks of storage, respectively.

These results' similar with ***El-Mongy (1990); Hoda (1994);and Afifi and El - Nashaby (2001).***

(5) Total Sporeforming bacterial count of Chicken meat.

Data presented in table (21) showed that the average counts of *sporeforming* bacteria in chicken meat samples as affected by gamma irradiation and subsequent cold storage at 5 ±1°c. The results indicated that *sporeformering* organisms were the most resistant type

Table (21): Effect of gamma irradiation on sporeform bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	2.5×10^2	2.397	4.3×10	1.633	1.9×10	1.278	8.0	0.903	5.0	0.698
7	1.0×10^3	3.000	1.0×10^2	2.000	6.3×10	1.799	2.2×10	1.342	9.0	0.954
14	6.2×10^4	4.792	9.3×10^2	2.968	3.3×10^2	2.518	6.0×10	1.778	1.6×10	1.204
21	---	---	1.1×10^4	4.041	1.0×10^3	3.000	2.1×10^2	2.322	4.4×10	1.643
28	---	---	---	---	7.2×10^3	3.857	8.0×10^2	2.903	1.4×10^2	2.146
35	---	---	---	---	---	---	6.2×10^3	3.792	7.1×10^2	2.851
42	-	-	---	---	---	---	-----	---	3.2×10^3	3.505
49	-	-	-	-	-	-	-	---	1.0×10^4	4.000
56	---	---	-	-	-	-	---	---	---	---

--- = No count

to irradiation, that even at dose level of 10 kGy consedarable numbers were still recovered, due probably to their low water content

El-Mongy (1990). During storage, their total numbers increased at a relatively slow rate under the unsuitable refrigerated temperature.

Where 2.5 x 10^2 for control sample and 4.3 x 10, 1.9 x 10, 8.0 and 5.0 c.f.u /g for irradiated samples receptively.

(6) Total Proteolytic bacterial count of Chicken meat:

Gamma irradiation was found to be very effective in reducing the *proteolytic* bacterial counts, A decrease of about 1.4, 1.9 and 2.3 log cycles were obtained when 2.5, 5 and 7.5 kGy doses were applied, respectively. At 10 kGy no growth was obtained during the first weeks of storage, while there are few cells were detected, which grew and increased in numbers till the samples were rejected at the end of 7 weeks- storage (Table 22). These results agree with *Khallafe (1982) and El- Mongy (1990).*

(7) Total Bacillus spp bacterial count of Chicken meat:

The data recorded in table (23) show the effect of different gamma irradiation doses on *Bacillus spp* count of chicken meat during cold storage, the results indicated that *Bacillus spp* organisms were the resistant type to irradiation, but the microbial numbers density of *Bacillus spp* slightly decreased with the irradiation dose increasing. From same table and figs that the total *Bacillus spp* count for control sample was $2.1 x 10^2$ c.f.u/g and slightly decreased by irradiation doses reached to 3.4x10, 1.4 x 10, 6.0 and 3.0 c.f.u / g when exposed to 2.5, 5.0, 7.5 and 10 kGy respectively. Unirradiated and irradiated samples their total numbers increased at relatively slow rate under the

Table (22): Effect of gamma irradiation on proteolytic bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	7.1×10^2	2.851	2.8×10	1.447	8.0	0.903	3.0	0.477	Nil	Nil
7	6.0×10^3	3.778	2.1×10^2	2.322	6.9×10	1.838	2.2×10	1.342	Nil	Nil
14	7.6×10^5	5.880	5.4×10^3	3.732	9.0×10^2	2.954	1.6×10^2	2.204	Nil	Nil
21	---	---	2.7×10^5	5.431	1.1×10^4	4.041	1.5×10^3	3.176	Nil	Nil
28	---	---	---	---	1.6×10^5	5.204	9.8×10^3	3.991	Nil	Nil
35	---	---	---	---	---	---	1.1×10^5	5.041	Nil	Nil
42	---	---	---	---	---	---	---	---	Nil	Nil
49	---	---	---	---	---	---	---	---	6.0	0.778
56	---	---	---	---	---	---	---	---	---	---

--- = No count Nil=No viable count

Table (23): Effect of gamma irradiation on Bacillus spp bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	2.1×10^2	2.322	3.4×10	1.531	1.4×10	1.141	6.0	0.778	3.0	0.477
7	9.5×10^2	2.977	6.8×10	1.832	2.6×10	1.414	9.0	0.954	4.0	0.602
14	5.1×10^3	3.707	2.0×10^2	2.301	8.0×10	1.903	1.8×10	1.255	6.0	0.778
21	--	--	1.9×10^3	3.278	3.0×10^2	2.477	3.3×10	1.518	1.0×10	1.000
28	--	--	--	--	9.2×10^2	2.963	9.1×10	1.959	2.0×10	1.301
35	--	--	--	--	--	--	3.7×10^2	2.568	4.0×10	1.602
42	--	--	--	--	--	--	--	--	8.0×10	1.903
49	--	--	--	--	--	--	--	--	1.4×10^2	2.146
56	--	--	--	--	--	--	--	--	--	--

--- = No count

refrigerated temperature reached to $5.1x10^3$ c.f.u /g for control sample and to $1.9x10^3$, $9.2x10^2$, $3.7x10^2$ and $1.4 x10^2$ c.f.u / g after 3, 4, 5 and 7 weeks for the ascending doses respectively. These results agree with ***Khallafe (1982); and El- Mongy (1990).***

(8) Total Clostridium spp bacterial count of Chicken meat

The effect of gamma irradiation on the *Clostridium spp* bacterial counts of chicken meat during cold storage determined in table (24).

The data showed that the use of gamma irradiation with dose level 2.5 kGy almost inhibited the few cells of *Clostridium spp* organisms that were present in samples before irradiation. As well as, few colonies of *Clostridium spp* were appeared after one week of storage in the irradiation (2.5 KGY) sample.

During cold storage the total *Clostridium spp* bacterial counts of unirradiated and irradiated chicken samples increased with the time of storage increasing reached to $3.1 x 10^2$ and 1.0 x 10 organisms / g at the end of the 2th and 3th weeks for unirradiated and irradiated chicken samples respectively. (table 24). These results agree with ***Khallafe (1982); and El- Mongy (1990).***

(9) Total Pathogenic bacterial count of Chicken meat:

The data in tables (25 -- 29) showed that the total count of ***Enterobacteriaceae*** (Table 25), ***Enterococcoci spp*** (Table 26), ***Coliform group*** (Table 27), ***Salmonella spp*** (Tabe28) and ***Staphylococlus spp*** (Table 29) induced by gamma irradiation at (2.5,5.0,7.5 and 10.0 kGy) and cold storage at (5±1 C) for Chicken meat.

Table (24): Effect of gamma irradiation on Clostridium spp bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.0 x 10	1.000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	4.0 x 10	1.602	3.4	0.531	Nil	Nil	Nil	Nil	Nil	Nil
14	3.1×10^2	2.491	7.2	0.857	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	1.0 x 10	1.000	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
35	---	---	---	---	---	---	Nil	Nil	Nil	Nil
42	---	---	---	---	---	---	---	---	Nil	Nil
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count   Nil=No viable count

However the previous members organisms were among the bacterial flora of the chicken samples, recovered before irradiation, but in relatively small numbers ranged from 3.0 c.f.u /g to 10^2 organisms/g (Tables 25-29).

During cold storage at 5±1°c, no obvious growth was detected due to that the temperature was not suitable for their growth and proliferation, the minimal dose of radiation applied (2.5kgy) was very effective in inhibiting these organisms that they were not recovered from the irradiated chicken samples also, that 5.0 kgy are quite enough to eliminate these pathogenic organisms. This coincides with the finding of ***Kramomtong and El - Fouly (1981),*** who found that ***Streptococcus faecalis*** disappeared from chicken carasses irradiated at dose level of 2.5 and 5.0 kGy the same result was found by ***Hammad (1985); and El- Mongy (1990).*** In addition these organisms were not detected in any irradiated samples

Similar results were reported by. ***Ingram and Simonsen (1980)***; ***Khallaf (1982); El mongy (1990); Hoda (1994); and Shawki (1998); and Afifi and El-Nashaby (2001)*** reported that small level of gamma irradition (1.5-2.5kGy) were sensitized to most pathogenic microorganisms

4-3-Effect of gamma irradiation and cold storage. On the microbial aspects of Fish flesh (carp)

The effect of gamma irradiation on the microbial Fish flesh (carp) during storage was determined in laboratory experiments Groups of freshly packed fish flesh were irradiated at different dose levels (2.5, 5.0, 7.5 and 10.0 KGY), stored at 5 ± 1°C and the changes were followed by examination of packages at suitable intervals.

Table (25): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.9×10^2	2.278	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	1.5×10^3	3.176	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	5.0×10^4	4.698	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
35	---	---	---	---	---	---	Nil	Nil	Nil	Nil
42	---	---	---	---	---	---	---	---	Nil	Nil
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count   Nil=No viable count

Table (26): Effect of gamma irradiation on Enterocococci spp bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	2.5×10^2	2.397	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	3.0×10^3	3.477	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	5.2×10^4	4.716	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	--	Nil	Nil	Nil	Nil	Nil	Nil
35	---	---	--	---	---	---	Nil	Nil	Nil	Nil
42	---	---	---	---	--	--	---	---	Nil	Nil
49	--	---	--	---	---	--	--	--	Nil	Nil
56	---	---	---	---	--	--	--	---	--	---

--- = No count Nil=No viable count

Table (27): Effect of gamma irradiation on coliform group bacterial count of Chicken during storage at (5±1 oC).

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	3.0	0.477	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	6.7 x 10	1.826	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	4.0 x 10^2	2.602	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	--	---	Nil	Nil	Nil	Nil	Nil	Nil
35	--	--	--	--	---	---	Nil	Nil	Nil	Nil
42	---	--	--	--	--	--	---	---	Nil	Nil
49	---	---	--	---	---	---	---	---	Nil	Nil
56	---	---	---	--	---	---	---	---	---	---

--- = No count Nil=No viable count

Table (28): Effect of gamma irradiation on Salmonella spp bacterial count of Chicken meat during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	5.0	0.698	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	2.0 x 10	1.301	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	8.5 x 10	1.929	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
35	--	--	---	---	--	--	Nil	Nil	Nil	Nil
42	--	--	---	---	---	---	--	--	Nil	Nil
49	--	--	---	---	--	---	--	---	Nil	Nil
56	---	---	---	---	---	---	--	--	--	---

--- = No count   Nil=No viable count

Table (29): Effect of gamma irradiation on Staphylococcus spp bacterial count of Chicken meat during cold storage.

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	8.0	0.903	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	9.8 x 10	1.991	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	6.0×10^3	3.778	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
35	--	--	---	--	--	--	Nil	Nil	Nil	Nil
42	---	---	---	---	---	---	---	--	Nil	Nil
49	--	---	---	---	---	--	---	---	Nil	Nil
56	---	---	---	---	--	---	---	--	---	--

--- = No count Nil=No viable count

Total Aerobic bacterial count of Fish flesh:

Fish flesh microbial safety and **shelf–life** depend on a large extant on contamination during, hanging, sliting, handling, marketing and on storage temperature ***EL- Mongy (1990); and Shawiki (1998).***

The results in table (30) show that the initial bacterial count of the control fish at zero time and before cold storage was 6.0×10^4 CFU/g. This value is within the range of values of fresh fish as reported by***; Nair and Nair (1988); Gelman et al., (1990); Ali et al., (1992); and Shawki (1998).*** The table indicates also that, a gradual increase in the total bacterial counts of the control sample was observed during cold storage and reached to 9.80×10^6 CFU/g. after one week of cold storage. At this stage, the control samples were completely rejected by the border line of fish acceptability for total microbial counts was found to be ($\geq 10^6$) cells/gm. as reported by ***Shawki (1998).*** This increment in the total bacterial count was expected as the fish is considered one of the most perishable food that is highly susceptible to microbial invasion ***(Khallaf 1982); and Afifi and El-Nashaby (2001).***

Application of gamma irradiation led to a great reduction in the microorganisms of treated fish flesh samples. Immediately after the radiation process, the total bacterial counts decreased from 6.0×10^4 CFU/g in the control sample to 2.2×10^3, 2.0×10^2, 2.6×10 and 9.0 CFU/ g. for exposing fish samples to 2.5, 5.0, 7.5 and 10 KGY, respectively. In other words the reduction percentages were 96.33/99.66/99.95 and 99.98% for the above mentioned doses, respectively. The greatest reduction in the bacterial load is mainly due to the direct and indirect effects of gamma irradiation on the

Table (30): Effect of gamma irradiation on Total aerobic bacterial count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	6.0×10^4	4.778	2.2×10^3	3.342	2.0×10^2	2.301	2.6×10	1.414	9.0	0.954
7	9.8×10^6	6.991	5.3×10^4	4.724	4.9×10^3	3.690	8.4×10^2	2.924	1.4×10^2	2.146
14	---	---	2.6×10^6	6.414	6.2×10^4	4.792	2.0×10^4	4.301	1.6×10^3	3.204
21	---	---	---	---	1.4×10^6	6.146	1.8×10^6	6.255	3.0×10^4	4.477
28	---	---	---	---	---	---	---	---	9.7×10^5	5.986
35	---	---	---	---	---	---	---	---	6.0×10^6	6.778
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count　　Nil=No viable count

microorganisms and the Effects of gamma irradiation as antibacterial agent as reported by ***Ibrahim (1980); Youssef (1981); Hagazy (1987); and Shawki (1998); and Afifi and El-Nashaby (2001).***

Moreover the data of table (30) show that, the total bacterial count gradually increased in the irradiated fish flesh samples by increasing the cold storage period. However, the samples were rejected after 2, 3, 3 and 5 weeks and the total bacterial counts reached to 2.6×10^6, 1.4×10^6, 1.8×10^6 and 6.0×10^6 CFU/g for the ascending doses, respectively. These results emphasized the findings of; ***Ibrahim, (1980); Youssef, (1981); Khallaf, (1982); Poole, et al., (1994); and Chen, et al., (1996); Shawki (1998); Shady (1999); and Afifi and El-Nashaby (2001).***

It is clear that the dose level of 10.0 KGy was the best one for keeping the total bacterial count of Fish at lower levels compared with other samples during cold storage extended, it's the shelf-life by three or five times as compared with the non irradiated fish flesh.

1- Total Anaerobic bacterial count of Fish flesh:

From table (31) shows the effect of different treatment irradiation doses and cold storage at 5 ± 1°C on the log and total anaerobic bacterial counts of fish flesh. From this tables it could be seen that at zero time, the count of anaerobic organisms of control fish flesh was 9.8×10^2 CFU/g and continuously increasing during cold storage to reached 9.1×10^4 CFU/g after one week and rejected at this stage. (the rejection of sample after one week depended up on the total aerobic bacterial count to reached at ($\geq 10^6$), and appearance of putrid smell as reported by ***Shawki (1998).*** From The same table and Figs it showed that the count of anaerobic bacterial count reduced by

Table (31): Effect of gamma irradiation on Total anaerobic bacteria count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	9.8×10^2	2.991	1.1×10^2	2.041	2.0 x 10	1.301	3.6	0.556	Nil	Nil
7	9.1×10^4	4.959	1.0×10^3	3.000	1.9×10^2	2.278	1.5 x 10	1.176	Nil	Nil
14	---	---	2.0×10^4	4.301	8.4×10^2	2.924	1.1×10^2	2.041	Nil	Nil
21	---	---	---	---	1.1×10^4	4.041	1.2×10^3	3.079	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count

Nil=No viable count

treatment with gamma irradiation from 9.8 x 10^2 CFU/g for control samples to 1.1x 10^2, 2.0 x 10 and 3.6 CFU/g for exposing fish samples to 2.5, 5.0, and 7.5 KGy respectively. However it is observed from same tables and Figs that the use of gamma irradiation with dose level 10.0 KGy destroyed all anaerobic bacteria on fish samples and another irradiation dose (2.5, 5.0, and 7.5 KGy) reduced the number of anaerobic microbial density on all irradiation samples. In addition the data in previous tables and Figs showed that the total anaerobic bacterial count gradually increased in irradiated fish samples during cold storage with increasing the time of storage until the samples were rejected at 2, 3, 3 and 5 weeks after irradiation doses. At 2.5, 5.0 and 7.5 KGY respectively. And the total anaerobic count of fish samples reached to 2.0 x 10^4, 1.1 x 10^4 and 1.2x10^3 CFU/g for ascending doses respectively also it observable that the gamma irradiation dose had a greater effect on anaerobic microorganism, the higher irradiation dose, the smaller anaerobic bacterial load on all irradiated fish samples comparing with unirradiated sample during cold storage. These results obtained by many investigator ***Ibrahim (1980); Khallaf (1982); pool et al., (1996); Shawki (1998); and Rady et al., (1999); and Afifi and El-Nashaby (2001).***

2- Total yeast and Mould count of Fish flesh:

The effect of gamma irratdiution and cold storage on the yeast and mould counts of the fish flesh are shown in table (32) it's clear from these results that the initial yeast and mould count of control fish samples at zero time was 1.3 x 10^2 CFU/g and this count increased progressively and reached 4.5 x 10^3 after one week of cold storage. The same table revealed also that irradiation at doses under investigation (5.0, 7.5, and 10 KGY) destroyed all cells of yeast and

Table (32): Effect of gamma irradiation on yeast and moulds count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.3×10^2	2.113	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	4.5×10^3	3.653	3.3×10	1.518	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	1.7×10^2	2.230	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count   Nil=No viable count

mould on fish flesh samples. Meanwhile the use of gamma irradiation with dose level of 2.5 KGY, almost inhibited. The few cells of yeast and moulds that were present in the samples before irradiation, However, few colonies of yeasts and moulds were appered after one week of storage in irradiated (2.5 KGY) samples. During cold storage of unirradiated and irradiated fish samples the total yeast and mould counts increased gradually and reached 4.5×10^3 and 1.7×10^2 CFU/g after 1 and 2 weeks of cold storage of samples (unirradiated and irradiated at 2.5 KGy) respectively. The same observations were also noticed by ***EL-Fouly et al., (1987); EL mongy (1990),;Hammad et al., (1995); Shawki (1998); and Afifi and El-Nashaby (2001).***

3- Total psychrophilic bacterial count of Fish flesh:

Many investigators reported that spoilage of fish under low temperature is nearly due to the ***{sychrophilic*** bacteria belonging namely to the genera ***Pseudomonas*** and ***Achromobacter***. These are generally accepted that the ***Psychrophilic*** bacteria, which are the main cause of spoilage of fish and fishery products are present in the slime, gills and intestines of newly caught fish or are picked up adventitiously during handling ***(Whittle et al., 1991).***

Data in table (33) show that the initial psychrophilic bacteria of control fish was 6.5×10^3 CFU/g. and gradually increased throughout cold storage and reached 1.7×10^6 CFU/g. after one week of cold storage whereat the control sample was completely rejected (the rejection of sample after one week depended up on the total aerobic bacterial count to reached to [(? 10^6) table (33)].

It could be noticed that irradiation at dose levels of 2.5, 5.0, and 7.5 KGY had great effect on ***Psychrophillic*** bacteria of treated

Table (33): Effect of gamma irradiation on psychrotrophilic bacterial count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	6.5×10^3	3.812	2.6×10^2	2.414	1.8×10	1.255	3.0	0.477	Nil	Nil
7	1.7×10^6	6.230	6.2×10^3	3.792	3.3×10^2	2.518	1.4×10	1.146	Nil	Nil
14	---	---	2.8×10^5	5.447	6.0×10^3	3.778	2.8×10^2	2.447	Nil	Nil
21	---	---	---	---	1.9×10^5	5.278	2.2×10^4	4.342	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count   Nil=No viable count

samples. The ***Psychrophillic*** group decreased from 6.5 x 10^3 CFU/g in control samples to 2.6 x 10^2, 1.8 x 10 and 3.0 CFU/g for fish samples subjected to 2.5, 5.0 and 7.5 KGY, respectively. Similar results were obtained by***; Youssef, (1981); El-Fouly, et al., (1987); and Abu-Shady, et al., (1994).*** Further more, the higher dose of radiation applied (10.0 KGY) was very effective in inhibiting these organisms (***Psychrophilic*** bacterial), that they were not recovered from the irradiated fish samples, at same dose (10.0 KGY). From same table (33) data indicates also that, a gradual increase in ***Psychrophillic*** bacteria has been observed during increasing storage period at 5±1°C, as mentioned before, the treated samples were rejected after 2, 3 and 3 weeks of cold storage and the ***Psychrophillic*** bacteria reached 2.8 x 10^5, 1.9 x 10^5 and 2.2 x 10^4 for the ascending doses, respectively. It is clear that 7.5 KGy was the effective dose in keeping the ***Psychrophillic*** group at low number during cold storage. This may be the reason for longest shelf-life of the later dose, since the ***Psychrophillic*** group is considered the principal cause of fish spoilage at low temperature ***(Yousef, 1981; El-Fouly, et al., (1987); Abu-Shady, et al., (1994); Shawki (1998); and Afifi and El-Nashaby (2001).***

4- Total Sporeform bacterial count of Fish flesh:

From table (34) revealed that the initial spore form bacterial count of control fish samples at zero time was 8.3 x 10^2 CFU/g. this count increased progressively and reached 1.0 x 10^5 CFU/g after one week of cold storage. The same table show that ***Sporeform*** organisms were the most resistant type to irradiation, that even at dose level of 10.0 KGY considerable numbers were still recovered, due probably to their low water content. During storage at 5±1 °C It was observed that

Table (34): Effect of gamma irradiation on sporeform bacterial count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	8.3×10^2	2.919	4.0×10	1.602	1.9×10	1.278	7.0	0.845	3.0	0.477
7	1.0×10^5	5.000	6.5×10^2	2.812	1.0×10^2	2.000	3.2×10	1.505	1.1×10	1.041
14	---	---	4.9×10^4	4.690	1.7×10^3	3.230	4.8×10^2	2.681	8.2×10	1.913
21	---	---	---	---	1.8×10^4	4.255	1.0×10^4	4.000	5.6×10^2	2.748
28	---	---	---	---	---	---	---	---	7.4×10^3	3.869
35	---	---	---	---	---	---	---	---	9.9×10^3	3.995
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count

the total ***Sporeform*** count increased gradually it were 4.0 x 10, 1.9 x 10 and 7.0 CFU/g) to reached 4.9 x 10^4, 1.8 x 10^4, 1.0 x 10^4 and 9.9 x 10^3 CFU/g after 2, 3, 3 and 5 weeks of cold storage for doses 2.5, 5.0, 7.5 and 10.0 KGY, respectively and these stages the samples were completely rejected. The same observation were also noticed by ***EL-Mongy (1990); and Hammad et al (1995).***

5- Total Protelytic bacterial count of Fish flesh:

Table (35) showed that the effect of gamma irradiation and cold storage on the ***Proteolytic*** bacterial count of fish flesh. The same table and figs show that gamma irradiation caused a noticeable reduction on ***Proteolytic*** count. A decrease of a bout 9.9 x 10^2 CFU/g for control sample at zero time to 1.6 x 10, 7.2 and 3.1 CFU/g were obtained when 2.5, 5.0 and 7.5 KGY doses were applied respectively. At 10.0 KGY no growth was obtained during the four weeks of storage, except for few cells which could be were detected from the end of the five week of storage at the samples were rejected (table 35). During cold storage of unirradiated and irradiated fish samples the total ***Proteolytic*** bacterial counts gradually increased and reached 8.0 x10^5 CFU/g for unirradiated sample 1.8 x 10^3, 4.0 x 10^3 and 1.9 x 10^2 CFU/g after 1, 2, 3 and 3 week at cold storage of samples exposed to 0.0, 2.5, 5.0, and 7.5 KGY doses, respectively and the fish samples were completely rejected. The same result were agree with ***(EL-Mongy (1990).***

6- Total Bacillus spp bacterial count of Fish flesh:

Data in table (36) show that the ***Bacillus spp*** organism of control fish was 5.2 x 10^2 CFU/g at zero time and sligtly increase during cold storage period to 1.3 x 10^4 CFU/g. after on week and it

Table (35): Effect of gamma irradiation on proteolytic bacterial count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	9.9×10^2	2.995	5.6 x 10	1.748	1.6 x 10	1.204	7.2	0.857	3.1	0.491
7	8.0×10^5	5.903	1.7×10^3	3.230	1.4×10^2	2.146	3.4 x 10	1.531	9.3	0.968
14	---	---	1.3×10^5	5.113	1.8×10^3	3.255	2.8×10^2	2.447	4.4 x 10	1.643
21	---	---	---	---	2.4×10^4	4.380	4.0×10^3	3.602	1.9×10^2	2.278
28	---	---	---	---	---	---	---	---	1.3×10^3	3.113
35	---	---	---	---	---	---	---	---	3.8×10^3	3.579
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count

Table (36): Effect of gamma irradiation on Bacillus spp bacterial count of Fish flesh during cold storage

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	5.2×10^2	2.716	7.1 x 10	1.851	2.1 x 10	1.322	6.5	0.812	1.7	0.230
7	1.3×10^4	4.113	4.0×10^2	2.602	6.0 x 10	1.778	2.2 x 10	1.342	3.0	0.477
14	---	--	3.2×10^3	3.505	3.1×10^2	2.491	9.7 x 10	1.986	6.0	0.778
21	---	---	--	---	1.5×10^3	3.176	4.9×10^2	2.690	1.4 x 10	1.146
28	---	--	---	---	---	---	---	---	3.3 x 10	1.518
35	--	--	---	---	---	---	--	--	1.0×10^2	2.000
42	---	--	--	---	---	---	---	--	---	--
49	--	---	---	---	---	--	---	---	Nil	Nil
56	---	---	---	---	--	---	---	--	---	--

--- = No count

was rejected at this stage. It could be noticed that the treatment with irradiation doses sligtly reduced the count of ***Bacillus spp*** from 1.3 x 10^4 CFU/g for the control fish sample to 7.1 x 10, 2.1x10, 6.5 and 1.7 CFU/g. for irradiated samples at 2.5, 5.0, 7.5 and 10.0 KGY doses respectively. The previous results indicated that ***Bacillus spp*** organisms were the one of resistant type to irradiation, that even at dose higher level considerable number were still recovered, due probably to their low count before irradiation. A gradual slightly increase was observed during storage. At 5±1 °C reaching 3.2 x 10^3, 1.5 x 10^3, 4.9 x 10^2 and 1.0 x 10^2 CFU/g after 2, 3, 3 and 5 weeks for the ascending doses respectively. At this stage the samples were completely rejected (by table of total aerobic bacterial count reached at 10^6). The same results are in agreement with ***[El- Mongy (1990); and Hammad (1996)].***

7- Total pathogenic bacterial count of Fish flesh:

Research with gamma irradiation has primarily focused on low-dose pasteurization of fish, fish products and shelf-fish. The principle reason that pasteurization levels (close to or above 10 KGY) will definitely effect the original sensory and physical qualities of seafood which would remove them form the fresh seafood market. Advantages of low-dose pasteurization include control or elimination of many pathogens and parasites as well as increase the shelf-life of these fresh seafood's for at least 1 week over life of the normal shelf-life. ***(Godoner and Andrews. 1991).*** *Staphylococcus aureus* is an important source of food poisoning throughout the world. This bacterium can contaminate several food and produce several types of entero toxins of remarkable stability to heat and radiation causing gastroenteritis ***(Halpin-Dohnalek and Marth, 1989).***

From tables **(37-42)** indicates that the members of ***Clostridium*** spp **(Table 37)**, ***Enterobacteriaceae*** **(Table 38)** ***Entrocococci spp*** **(Table 39)**, ***Coliform group*** **(Table 40)**, ***Salmonella spp*** **(Table 41)** and ***Staphylococcus spp*** **(Table 42)**. These members were among the bacterial flora of the fish samples, recovered before irradiation, but in relatively small numbers tables (37-42) ranged from 1.7 CFU/g to 10^2 organisms/g. From the same tables it could be noticed that using 2.5 KGY gamma radiation was sufficient for complete elimination of these organisms in fish flesh samples. In addiation, that the dose 5.0 KGY are quite enough to limonite these organisms. This coincides with the finding of ***(Kramomtong and El-Fouly (1981); and El Mongy (1990)***. Data in same tables (37-42) show that the total count of these microorganisms in fish unirradiated samples increasing with the time of storage increasing. After one week of cold storage the samples were completely rejected (by table (30) of total aerobic bacterial count reached at (10^6) all previous result were similar with ***Ingram and Simonsen (1980); Khallaf (1982); Hammad (1985); El mongy (1990); Hoda (1994); Hammad (1996); Shawki (1998); and Afifi and El-Nashaby (2001).***

4-4- Effect of gamma irradiation and storage at room temperature on the chemical composition of Dry Fish (wazaf)

(1) Moisture content of Dry Fish (wazaf):

The shelf-life of stored fish mainly determined by freshness tests and total microbial tests which are used to assess the quality of meat. Application of food preservation induced several effects on food components depend on the dose level, composition of foods, temperature during irradiation, etc. several workers investigated

Table (37): Effect of gamma irradiation on Clostridium spp bacterial count of Fish flesh during cold storage.

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.8 x 10	1.255	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	6.0×10^2	2.778	2.0	0.301	Nil	Nil	Nil	Nil	Nil	Nil
14	--	--	8.0	0.903	Nil	Nil	Nil	Nil	Nil	Nil
21	--	--	---	--	Nil	Nil	Nil	Nil	Nil	Nil
28	--	--	--	--	--	--	--	---	Nil	Nil
35	---	--	--	--	--	--	--	--	Nil	Nil
42	---	--	--	--	--	--	--	---	Nil	Nil
49	--	---	---	---	---	--	---	---	---	---
56	---	---	---	---	--	---	---	--	Nil	Nil
									---	--

--- = No count

Nil=No viable count

Table (38): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Fish flesh during cold storage.

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	3.6×10^2	2.556	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	9.5×10^4	4.977	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count Nil=No viable count

Table (39): Effect of gamma irradiation on Enterocococci spp bacterial count of Fish flesh during cold storage.

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	3.8×10^2	2.579	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	7.0×10^4	4.845	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count

Nil=No viable count

Table (40): Effect of gamma irradiation on coliform group bacterial count of Fish flesh during cold storage .

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	2.0	0.301	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	2.9×10^2	2.462	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	Nil	Nil
56	---	---	---	---	---	---	---	---	---	---

--- = No count Nil=No viable count

Table (41): Effect of gamma irradiation on Salmonella spp bacterial count of Fish flesh during cold storage .

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.7	0.230	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	3.1 x 10	1.491	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	---	---	Nil	Nil
42	---	---	---	---	---	---	---	---	Nil	Nil
49	---	---	---	---	---	---	---	---	---	---
56	---	---	---	---	---	---	---	---	Nil	Nil
									---	---

--- = No count

Nil=No viable count

Table (42): Effect of gamma irradiation on Staphylococcus spp bacterial count of Fish flesh during cold storage .

Dose (KGY)	0.0		2.5		5.0		7.5		10.0	
Storage Period (in days)	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log	Count / g	Log
0	1.8×10	1.255	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	7.0×10^3	3.845	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	---	---	---	---	Nil	Nil	Nil	Nil	Nil	Nil
28	---	---	---	---	---	---	---	---	Nil	Nil
35	---	---	---	---	---	---	--	---	Nil	Nil
42	---	---	---	---	---	--	--	---	---	---
49	--	---	---	---	---	--	---	---	Nil	Nil
56	---	---	---	---	--	---	---	--	---	--

--- = No count Nil=No viable count

irradiation the effect of gamma irradiation on the main food as well as the minor constituents.

Data given table (43) show the changes in moisture content of Dry fish (wazaf) as affected by gamma irradiation of different levels (1.5 and 3.0 KGY) then room temperature storage for 210 days (7 months). From this table it could be noticed that the moisture content before storage at zero time were 31.98, 13.95 and 13.48% for doses 0.0, 1.5 and 3.0 KGY respectively. For further, it is obvious from the same table that gamma irradiation doses under testing (1.5 and 3.0 KGY) had no effect on the major moisture content of Dry fish comparing with the control samples at (0.0 KGY). Agree with *Khallaf (1982), Nessrien (1997), and Shawki (1998),*

However, the moisture content of differently treated (0.0, 1.5 and 3.0 KGY) Dry fish samples were slightly decreased as the time of storage increased, as it reached After 210 days to 13.74, 13.71 and 31.30% for treated Dry fish samples to (0.0, 1.5 and 3.0 KGY) respectively, this slight decrease may be due to the small evaporation of moisture from the outer surface of the dry fish during storage at room temperature.These results agree with *Nessrien (1997); Hassanin (1997); Shawki (1998); and Afif and El-Nashaby (2001).*

(2) Protein content of Dry Fish (wazaf):

The changes in total protein content of Dry fish (wazaf) as affected by gamma irradiation and storage at room temperature for 210 days (7 months) are shown in table (44). It is evident from the results in table (44) that gamma irradiation doses under taken had no effect on protein content of Dry fish samples. The protein content of

Table (43): Effect of gamma irradiation on the moisture content of dry fish (wazaf) , during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	13.98	0.000	13.95	0.000	13.48	0.000
30	13.94	-0.286	13.93	-0.143	13.45	-0.222
60	13.91	-0.500	13.89	-0.430	13.42	-0.445
90	13.87	-0.786	13.85	-0.716	13.40	-0.593
120	13.84	-1.001	13.82	-0.931	13.37	-0.816
150	13.80	-1.287	13.78	-1.218	13.35	-0.964
180	13.77	-1.502	13.74	-1.505	13.32	-1.186
210	13.74	-1.716	13.71	-1.720	13.30	-1.335

Table (44): Effect of gamma irradiation on the total protein content of dry fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	78.88	0.000	78.59	0.000	78.42	0.000
30	78.82	-0.050	78.54	-0.063	78.38	-0.031
60	78.76	-0.152	78.47	-0.152	78.34	-0.162
90	78.72	-0.202	78.45	-0.178	78.32	-0.127
120	78.64	-0.304	78.43	-0.203	78.26	-0.204
150	78.59	-0.367	78.36	-0.292	78.24	-0.229
180	78.52	-0.456	78.33	-0.330	78.19	-0.293
210	78.46	-0.532	78.27	-0.407	78.16	-0.331

control sample and irradiated samples at 1.5 and 3.0 kGY was 78.88, 78.59, and 78.42%, respectively.

These results agreed with those obtained by ***Hegazy (1987); EL-Mongy (1990); Hoda (1994); and Shawki (1998)***. The same phenomena was also observed up on the storage of both unirradiated and irradiated dry fish samples, as the protein content of dry fish samples showed slightly decreased during storage at room temperature for 210 days the protein content of unirradiated and irradiated Dry fish samples at 1.5 and 3.0 KGY. Were 78.46, 78.27 and 78.16% after 210 days respectively. The slight decrease of protein content might be due to decomposition of tissues by microorganisms. Similar observations were obtained by ***Nessrien (1997); Kraima (1997), Shwaki (1998); Shady (1999),;and Afif and El-Nashaby (2001).***

(3) Fat content of dry Fish (wazaf):

The data present in table (45) showed that the effect of gamma irradiation (1.5 and 5.0 KGY) on the fat content of dry fish (wazaf) during storage at room temperature it is obvious that the gamma irradiation had no effected on fat content. From same table the fat content for control sample and samples irradiated at 1.5 and 3.0 KGY before storage were 8.25, 8.16 and 8.12% while the fat content for the same samples after storage for 7 months at room temperature was 8.13, 8.08 and 8.04% respectively.

It is clear the fat content slightly decreased with increasing the time of storage. These slight decreased may be due to active of microorganism which secrete lipase enzymes that cause oxidation of fats which was be also responsible for the slight decrease of total lipids content during room temperature storage. These results agreed

Table (45): Effect of gamma irradiation on the fat content of dry fish (wazaf) during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	8.25	0.000	8.16	0.000	8.12	0.000
30	8.22	-0.363	8.15	-0.122	8.10	-0.246
60	8.24	-0.121	8.14	-0.245	8.09	-0.369
90	8.19	-0.727	8.11	-0.612	8.08	-0.492
120	8.18	-0.848	8.12	-0.490	8.10	-0.246
150	8.16	-0.090	8.09	-0.857	8.06	-0.738
180	8.15	-1.212	8.09	-0.857	8.05	-0.862
210	8.13	-1.454	8.08	-0.980	8.04	-0.985

with those obtained by ***Hassanin (1997); Nessrien (1997); and Afif and El-Nashaby (2001).***

(4) Ash content of Dry fish (wazaf):

Table (46) declared the ash content of dry fish induced by room temperature storage and gamma irradiation (1.5 and 3.0 KGY). There for it is obvious from the data obtained in table (46) that ash content of unirradiated and irradiated dry fish samples before and after storage at room temperature for 210 days was the same (about 11.9%). The results agreed with those obtained by ***EL Tanahy (1987); Hoda (1994); EL-Mongy (1990); Nessrien (1997); and Afif and El-Nashaby (2001).***

(5) Carbohydrate content of Dry Fish(wazaf):

The effect of gamma irradiation on carbohydrate content of dry fish during storage at room temperature the data present in table (47) it is obvious from these results that the applied doses of gamma irradiation had no remarkable effects on the carbohydrate content of dry fish samples. Since the carbohydrate contents were 0.91, 1.27 and 1.50% for treatments to 0.0, 1.5 and 3.0 KGY gamma irradiation respectively. As well as the same table indicates that the Carbohydrate content of unirradiated and irradiated samples under study slight increased during storage at room temperature reached to 1.4, 1.6 and 1.8% after 210 days for treatment to 0.0, 1.5 and 3.0 KGY respectively. These effects might be due to evaporation of water from the outer surface of dry fish during storage at room temperature and may be due to changes the other chemical composition contents induced by room temperature storage. Similar results was reported by ***(EL- Shamary 1988); and Afif and El-Nashaby (2001).***

Table (46): Effect of gamma irradiation on the ash content of dry fish(wazaf) during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	11.957	0.000	11.972	0.000	11.959	0.000
30	11.958	0.008	11.980	0.066	11.958	-0.008
60	11.957	0.000	11.980	0.066	11.960	0.008
90	11.956	-0.008	11.971	-0.008	11.960	0.008
120	11.957	0.000	11.969	-0.025	11.9570	-0.016
150	11.954	-0.025	11.979	0.025	11.958	0.008
180	11.956	-0.008	11.971	-0.008	11.959	0.000
210	11.957	0.000	11.975	0.025	11.958	-0.008

Table (47): Effect of gamma irradiation on the carbohydrate (carb.) content of dry fish (wazaf) during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	carb. %	Increase %	carb. %	Increase %	carb. %	Increase %
0	0.913	0.000	1.278	0.000	1.501	0.000
30	0.982	7.557	1.330	5.520	1.562	4.063
60	1.043	13.384	1.410	11.119	1.610	7.261
90	1.134	23.068	1.469	15.220	1.640	9.260
120	1.223	32.861	1.481	16.088	1.683	12.125
150	1.296	40.696	1.571	23.895	1.742	16.055
180	1.374	49.727	1.609	28.548	1.801	19.986
210	1.453	58.650	1.675	31.782	1.842	22.918

(6) Total volatile Basis Nitrogen (T.V.B.N) of Dry Fish (wazaf):

Data concerning the Total volatile Basis Nitrogen (T.V.B.N) (mg N/100 g) of unirradiated and irradiated dry fish (wazaf) samples during room temperature storage are shown in table (48).

Aslightly increase in the T.V.B.N was noticed after irradiation of dry fish samples, this increase was more in higher doses, as it was 12.78 mg N/ 100g in the unirradated dry fish sample and reached up to 12.84 and 12.97 mg N /100g in the samples irradiated with 1.5 and 3.0 KGY respectively this might be due to the direct effect of irradiation on some free amino acids leading to the for mation of samall amount of ammonia. ***Khallaf (1982); Hassanin (1997); Nessrien (1997); and Afif and El-Nashaby (2001).***

From same table it could be noticed that the T.V.B.N content slightly increased rapidly during storage at room temperature which could be ascribed to the Marked growth and activity of microorganisms. As well as the increase in bacterial counts it being 19.88, 18.87 and 18.61 mgn/100g. After 210 days for unirradiated and irradiated dry fish samples to 0.0, 0.2 and 3.0 KGY respectively as reported by ***Pool, et al (1996); Hassanin (1997); and Afif and El-Nashaby (2001).***

(7) Thiobarbituric Acid value (T.B.A) of Dry Fish (wazaf)

Table (49) illustrate the T.B.A value as parameter for autoxidation of dry fish lipid during irradiation and storage at room temperature, for 210 days. Data obtained in same table indicate that the T.B.A value which slight increased by increasing the irradiation dose, as the T.B.A was 0.175 mg N/100g in control sample while it

Table (48): Effect of gamma irradiation on the total volatile basis nitrogen (T.V.B.N) content of dry fish (wazaf) during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	T.V.B.N	Increase %	T.V.B.N	Increase %	T.V.B.N	Increase %
0	12.78	0.000	12.84	0.000	12.97	0.000
30	13.66	6.885	13.70	6.697	13.76	6.090
60	14.54	13.771	14.56	13.395	14.58	12.413
90	15.43	20.735	15.45	20.327	15.37	18.504
120	16.34	27.856	16.28	26.791	16.20	24.903
150	17.22	34.741	17.14	33.489	16.97	30.840
180	18.19	42.331	18.02	40.342	17.82	37.393
210	19.88	55.555	18.87	46.962	18.61	43.484

Table (49): Effect of gamma irradiation on the thiobarbituric acid value (T.B.A) content of dry fish (wazaf) during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	T.B.A	Increase %	T.B.A	Increase %	T.B.A	Increase %
0	0.175	0.000	0.205	0.000	0.219	0.000
30	0.194	10.857	0.222	8.292	0.240	9.589
60	0.214	22.285	0.239	16.585	0.262	19.634
90	0.234	33.714	0.256	24.878	0.284	29.680
120	0.254	45.142	0.273	33.170	0.305	39.269
150	0.274	56.571	0.290	41.463	0.327	49.315
180	0.294	68.00	0.307	49.756	0.349	59.360
210	0.324	85.142	0.325	58.536	0.371	69.400

reached up to 0.205 and 0.219 mg N /100g in samples irradiated with doses of 1.5 and 3.0 KGY respectively.

After 210 days storage at room temperature the T.B.A value of unirradiated and irradiated dry fish samples slightly increased to reached.324 mg/100g in unirradisted sample while was 3.25 and 0.371 mg/100g in samples irradiated with doses of 1.5 and 3.0 KGY respectively, indicating the oxidation of lipids. Generally, the storage led to an increase in the T.B.A value in all treatments including the control owing to the progressive lipids oxidation. It is worthy to oxidation of fat could also occur by the effect of microorganisms.

All previous results are in agreement with ***Bayoumy (1986); Nessrien (1997); Kraima (1998); and Shady (1999).***

(8) pH value of Dry fish (wazaf)

It is obvious from the result in table (50) that the change in pH value due to either gamma irradiation treatment of room temperature storage. pH value was 6.79 in control samples reached to 6.58 and 6.37 for samples subjected to 1.5 and 3.0 KGY gamma ray doses respectively.

However, during storage at room temperature, the pH value was 6.64, 6.50 and 6.29 for control and dry fish treated with 1.5 and 3.0 KGY after 210 respectively. No significant differences were recorded in pH values (table 50) due to gamma irritation (1.5 and 3.0 KGY) or storage at room temperature. For 210 days. These results are agree with those established by ***Khallaf (1982); Shaltout (1989); EL-Mongy (1990); Khallaf (1996) and Shawki (1998).***

Table (50): Effect of gamma irradiation on the pH value of dry fish (wazaf) during storage at roomtemperature .

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	pH value	Decrease %	pH value	Decrease %	pH value	Decrease %
0	6.79	0.000	6.58	0.000	6.37	0.000
30	6.77	-0.294	6.56	-0.303	6.36	-0.156
60	6.73	-0.883	6.57	-0.151	6.35	-0.313
90	6.74	-0.736	6.55	-0.455	6.33	-0.627
120	6.71	-1.178	6.55	-0.455	6.32	-0.784
150	6.69	-1.472	6.53	-0.759	6.31	-0.941
180	6.67	-1.767	6.52	-0.918	6.30	-1.098
210	6.64	-2.209	6.50	-1.215	6.29	-1.255

4-5- Effect of gamma irradiation on the microbial aspects of Dry Fish (wazaf) during storage at room temperature.

Fish is considered to be a suitable medium for the growth of many organisms, such as Bacteria, Molds and yeast. The microbial activity lead to certain in flavor, color and the accumulation of toxins in meat. The shelf-life of dry fish was found to be dependent up on initial microbial counts, storage temperature, Transportion and irradiation dose. Application of irradiation techniques was been success fully used to control bath spoilage microorganisms contamination of food and extending the shelf-life of food at room temperature storage.

(1) Total Aerobic bacterial count of Dry Fish.(wazaf)

From table (51) shows that the effect of different treatment irradiation dose on the total aerobic bacterial count of dry fish during storage at room temperature. From this table and figures it could be seen that at zero time, the unirradiated dry fish had 1.2 x 10^4 cell/ gm. This value is within the range given for dry fish as reported by ***Khallaf (1982); and EL- Tanahy (1987)*** just after irradiation of the dry fish samples with 1.2 and 3.0 KGy, the bacterial load reduced to 9.9 x 10^2 and 6.3x10 C.F.U/g.

In other words the reduction percentages were 91.75 and 99.48% for the above mentioned doses on comparing. With their unirradiated samples respectively. The reduction of total bacterial counts attributed to the cold sterilization effect of irradiation on the microorganisms. Agree with (Khallaf 1982), who reported that the irradiation doses of 1.5, 2.5 and 3.5 KGY could reduce the

Table (51): Effect of gamma irradiation on total of aerobic bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$1.8X10^4$	4.255	$3.2X10^3$	3.505	$3.0X10^2$	2.477
30	$4.5X10^4$	4.653	$9.0X10^3$	3.954	$6.7X10^2$	2.826
60	$6.7X10^4$	4.826	$1.3X10^4$	4.113	$9.0X10^2$	2.954
90	$1.1X10^5$	5.041	$1.9X10^4$	4.278	$1.2X10^3$	3.079
120	$1.5X10^5$	5.176	$2.7X10^4$	4.431	$1.6X10^3$	3.204
150	$2.0X10^5$	5.301	$3.8X10^4$	4.579	$2.2X10^3$	3.342
180	$3.4X10^5$	5.531	$5.3X10^4$	4.724	$2.9X10^3$	3.462
210	$8.1X10^5$	5.908	$7.8X10^4$	4.892	$3.6X10^3$	3.556

percentages of microorganisms from 0.0% of controls to 22.47, 12.26 and 2.39% for the above doses respectively.

(FAO/ IAEA) division of atomic energy in food and ***Agriculture, (1980)***, reported that, initial bacterial counts of carp and gwyniad were 10^4 - 10^5cell/ gm. This counts were reduced to be less than 100 cells/gm after being treated with 1 KGY. The aforementioned results agree with ***khallaf (1982); Shawik (1998);and Afifi and El-Nashaby (2001).***

During subsequent room temperature storage slight increase in total bacterial counts was noticed on unirradiated and irradiated dry fish samples. It reached to 8.9 x 10^5, 1.1 x 10^4 and 6.4 x 10^2 C.F.U/g after 210 days for treated samples with 0.0, 1.5 and 3.0 KGY Respectively. The increasing in unirradiated dry fish samples higher than irradiated samples. There fore during room temperature storage the aerobic microbial count decreased with increasing the irradiation doses the higher irradiation dose the greater reduction of aerobic bacterial load on irradiated dry fish samples.

From the aforementioned data it is clear that the 3.0 KGY treatment is the best for keeping the total aerobic bacterial counts of dry fish at lower level during room temperature storage and hence, give the longest shelf-life. These results are in agreement with those obtained by ***Khallaf (1982); El-Tanahy (1987); EL-Mongy (1990); Shawki (1998); Shady (1999); and Afifi and El-Nashaby (2001).***

(2) Total Anaerobic bacterial count of Dry Fish (wazaf):

The results in table (52) illustrate the effect of gamma irradiation on anaerobic bacterial counts of dry fish before and after irradiation, during storage at room temperature for 210 days

Table (52): Effect of gamma irradiation on total anaerobic bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$4.1X10^2$	2.612	7.4X10	1.869	1.4X10	1.146
30	$5.6X10^2$	2.748	$1.1X10^2$	2.041	1.9X10	1.278
60	$6.4X10^2$	2.806	$1.4X10^2$	2.146	3.0X10	1.477
90	$9.7X10^2$	2.986	$1.9X10^2$	2.278	3.4X10	1.531
120	$1.3X10^3$	3.113	$2.8X10^2$	2.447	4.6X10	1.662
150	$1.8X10^3$	3.255	$3.7X10^2$	2.568	6.1X10	1.785
180	$2.2X10^3$	3.342	$5.2X10^2$	2.716	8.0X10	1.903
210	$3.3X10^3$	3.518	$6.8X10^2$	2.832	$1.2X10^2$	2.079

(7 months). It is evident from these results that the unirradiated dry fish sample at zero time had 4.1 x 10^2 C.F.U/g and reduced to 7.4 x 10 and 1.4 x 10 C.F.U/g when exposed to 1.5 and 3.0 KGY respectively. The reduction in the Anaerobic bacterial load is mainly due to direct and indirect effects of gamma irradiation on this microorganisms. As reported by ***Hoda (1994); and Shawki (1998).*** From the same table it could be noticed that, the total anaerobic bacterial counts of unirradiated and irradiated dry fish samples slight increasing during storage at room temperature after 210 days. The counts reached to 3.3 x 10^3 C.F.U/g for unirradiated sample for samples and 6.8 x 10^2 and 1.2 x 10^2 C.F.U/g) for exposed to 1.5 and 3.0 KGY respectively. This coincides with the finding of ***Khallaf (1982); EL-Mongy (1990); and Shawiki (1998).***

(3) Total Spore form bacterial count of Dry Fish(wazaf):

The spore form bacterial counts of dry fish induced by gamma irradiation and stored at room temperature seen in table (53) The results indicted that spore form organism were the most resistant type to irradiation, that even at dose level of 3.0 KGY. However the spore form counts before storage of unirradiated and irradiated dry fish sample were 7.1 x 10^2 C.F.U/g, for unirradiated sample and was 1.2 x 10^2 and 3.6 x 10 C. F. U/g for irradiated sample at 1.5 and 3.0 KGY respectively. Furthermore During storage their total counts numbers increased at relatively slow rate with the time of storage increasing under the same condition of storage. The same results are in agreement with ***EL-Mongy (1990); and Hammad (1996).***

Table (53): Effect of gamma irradiation on sporeform bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$7.1X10^2$	2.851	$1.2X10^2$	2.079	3.6X10	1.556
30	$9.3X10^2$	2.968	$1.5X10^2$	2.176	4.0X10	1.602
60	$1.1X10^3$	3.041	$1.9X10^2$	2.278	5.0X10	1.698
90	$1.5X10^3$	3.176	$2.0X10^2$	2.301	5.4X10	1.732
120	$2.0X10^3$	3.301	$2.4X10^2$	2.380	6.0X10	1.778
150	$2.7X10^3$	3.431	$3.2X10^2$	2.505	6.8X10	1.832
180	$3.3X10^3$	3.518	$4.8X10^2$	2.681	7.7X10	1.886
210	$4.5X10^3$	3.653	$5.7X10^2$	2.755	9.0X10	1.954

(4) Total Proteolytic bacterial count of Dry Fish (wazaf) :

Data presented in table (54) showed that the average counts of protolytic bacteria in dry fish samples as effected by irradiation and subsequent room temperature storage. From previous table and figs showed that the gamma irradiation was found to be reducing the protolytic counts a decrease of about 8.0 x 10^2 C.F.U/g for control dry fish sample to 1.1x10^2 and 8.0 C.F.U/g for irradiated dry fish samples when exposed to 1.5 and 3.0 KGY respectively.

In other hand the reduction percentage were 86.25 and 99.0% for the ascending doses comparing with control dry fish sample respectively.

As well as during storage at room temperature the total protolytic bacterial counts of unirradiated and irradiated dry fish samples were increased with storage time increasing, but with different rates the higher, the irradiation dose, the lower rate of increase. This might be due the proteins firstly break. Down into amino acids, and then the break-down of amino acids take place during the bacterial decomposition under these conditions of room temperature storage. Those results are in accordance with those of ***Khalaf, and marth (1984); EL-Tanahy (1987); El mongy (1990); and Shawki (1998).***

(5) Total Bacillus spp bacterial count of Dry Fish (wazaf):

Table (55) it could be noticed the total *Bacillus spp* counts (C.F.U./g) of irradiated and control dry fish storage at room temperature. It is obvious from the same table and figs that the initial *Bacillus spp* counts of control dry fish sample at zero time and before storage was 7.6 x 10 C.F.U/g and slightly increase during room

Table (54): Effect of gamma irradiation on protolytic bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$8.0X10^2$	2.903	$1.1X10^2$	2.041	8.0	0.903
30	$1.2X10^3$	3.079	$1.6X10^2$	2.204	1.2X10	1.179
60	$2.8X10^3$	3.447	$3.3X10^2$	2.518	2.0X10	1.301
90	$4.2X10^3$	3.623	$6.2X10^2$	2.792	4.3X10	1.633
120	$9.3X10^3$	3.968	$1.5X10^3$	3.176	8.0X10	1.903
150	$2.4X10^4$	4.380	$2.9X10^3$	3.462	$1.5X10^2$	2.176
180	$3.4X10^4$	4.531	$5.7X10^3$	3.755	$3.4X10^2$	2.531
210	$9.9X10^4$	4.991	$1.1X10^4$	4.041	$6.6X10^2$	2.819

Table (55): Effect of gamma irradiation on Bacillus spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	7.6X10	1.880	1.6X10	1.204	1.8	0.255
30	$1.1X10^2$	2.041	2.4X10	1.380	1.9	0.278
60	$1.7X10^2$	2.230	2.8X10	1.447	2.8	0.447
90	$1.9X10^2$	2.278	5.8X10	1.763	5.0	0.698
120	$3.6X10^2$	2.556	6.1X10	1.785	6.2	0.792
150	$4.2X10^2$	2.623	$1.2X10^2$	2.079	9.0	0.954
180	$8.0X10^2$	2.903	$1.8X10^2$	2.255	1.3X10	1.113
210	$9.9X10^2$	2.995	$2.6X10^2$	2.414	1.7X10	1.230

temperature storage to reached 9.9×10^2 C.F.U/g. after 210 days. Application of gamma irradiation led to slight reduction in *Bacillus spp* microorganism, this result may be due to *Bacillus* organism were resistant type to irradiation like Sporeform bacteria. But microbial numbers slightly decreased with the irradiation dose increasing, it was 1.6×10 and 1.8 C.F.U/g when exposed to 1.5 and 3.0 KGY respectively. The table indicates also that the *Bacillus spp* count of irradiated dry fish samples slightly increase during storage at room temperature to reached 2.6×10^2 and 1.7×10 C.F.U/g, after 210 days when irradiated at doses of 1.5 and 3.0 KGY respectively, were used. From same table it is clear that the dose level of 3.0 KGY was the best one for keeping the total *Bacillus spp* count of dry fish at lower levels compared with control sample during storage at room temperature.

(6) Total Pathogenic organisms count of Dry Fish (wazaf):

Fish are a susceptible to contaminate by various types of microorganisms including both spoilage and pathogenic microorganisms. In addition, to the natural flora on the skin other contamination may reach from the fresh seafood market and handling. Contamination may also occur during plucking, evisceration and washing. Radiation was resistance and sensitivity of different species of microorganisms. Application of irradiation dose was been successfully used to control pathogenic microorganisms contamination of food.

Data in tables (56-63) revealed that the pathogenic organisms under investigation are Yeast and Mould (Table 56), Clostridium spp (Table 57), Enterobacteriaceae (Table 58), Enterocococci spp (Table 59) Coliform group (Table 60), Salmonella spp (Table 61), Staphylococcus spp (Table 62) and Streptococcus spp (Table 63),

Table (56): Effect of gamma irradiation on total yeast and mould count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	8.0X10	1.903	Nil	Nil	Nil	Nil
30	9.8X10	1.986	Nil	Nil	Nil	Nil
60	$1.2X10^2$	2.079	Nil	Nil	Nil	Nil
90	$1.5X10^2$	2.176	Nil	Nil	Nil	Nil
120	$1.7X10^2$	2.230	Nil	Nil	Nil	Nil
150	$2.2X10^2$	2.341	Nil	Nil	Nil	Nil
180	$2.6X10^2$	2.414	Nil	Nil	Nil	Nil
210	$3.4X10^2$	2.531	Nil	Nil	Nil	Nil

Nil=No viable count

Table (57): Effect of gamma irradiation on Clostridium spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.0X10	1.602	1.3X10	1.113	3.0	0.477
30	4.8X10	1.681	1.5X10	1.176	4.0	0.602
60	5.9X10	1.770	1.9X10	1.278	4.4	0.643
90	7.4X10	1.869	2.2X10	1.342	4.9	0.690
120	8.8X10	1.944	2.5X10	1.397	6.0	0.778
150	$1.1X10^2$	2.041	3.0X10	1.477	8.0	0.845
180	$1.3X10^2$	2.113	3.6X10	1.556	8.2	0.913
210	$1.8X10^2$	2.255	4.1X10	1.612	9.5	0.977

Nil=No viable count

Table (58): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$1.0X10^2$	2.000	1.8	0.255	Nil	Nil
30	$2.2X10^2$	2.342	2.0	0.301	Nil	Nil
60	$3.0X10^2$	2.477	2.7	.0431	Nil	Nil
90	$3.8X10^2$	2.579	3.8	0.579	Nil	Nil
120	$5.4X10^2$	2.732	6.0	0.778	Nil	Nil
150	$9.7X10^2$	2.986	7.7	0.886	Nil	Nil
180	$1.9X10^3$	3.278	1.1X10	1.041	Nil	Nil
210	$5.0 X10^3$	3.698	1.4X10	1.146	Nil	Nil

Nil=No viable count

Table (59): Effect of gamma irradiation on Enterocococci spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	5.4X10	1.732	Nil	Nil	Nil	Nil
30	7.6X10	1.880	Nil	Nil	Nil	Nil
60	$1.1X10^2$	2.041	Nil	Nil	Nil	Nil
90	$1.6X10^2$	2.204	Nil	Nil	Nil	Nil
120	$2.2X10^2$	2.342	Nil	Nil	Nil	Nil
150	$3.5X10^2$	2.544	Nil	Nil	Nil	Nil
180	$4.4X10^2$	2.643	Nil	Nil	Nil	Nil
210	$7.5X10^2$	2.875	Nil	Nil	Nil	Nil

Nil=No viable count

Table (60): Effect of gamma irradiation on coliform group bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.4X10	1.146	Nil	Nil	Nil	Nil
30	1.8X10	1.255	Nil	Nil	Nil	Nil
60	2.9X10	1.431	Nil	Nil	Nil	Nil
90	3.5X10	1.544	Nil	Nil	Nil	Nil
120	5.7X10	1.755	Nil	Nil	Nil	Nil
150	8.6X10	1.934	Nil	Nil	Nil	Nil
180	$1.3X10^2$	2.113	Nil	Nil	Nil	Nil
210	$1.9X10^2$	2.278	Nil	Nil	Nil	Nil

Nil=No viable count

Table (61): Effect of gamma irradiation on Salmonella spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	Nil	Nil	Nil	Nil	Nil	Nil
30	2.0	0.301	Nil	Nil	Nil	Nil
60	3.0	0.477	Nil	Nil	Nil	Nil
90	3.0	0.477	Nil	Nil	Nil	Nil
120	4.0	0.602	Nil	Nil	Nil	Nil
150	7.0	0.845	Nil	Nil	Nil	Nil
180	1.1X10	1.041	Nil	Nil	Nil	Nil
210	1.1X10	1.041	Nil	Nil	Nil	Nil

Nil=No viable count

Table (62): Effect of gamma irradiation on Staphylococcus spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$5.1X10^2$	2.707	Nil	Nil	Nil	Nil
30	$7.5X10^2$	2.875	Nil	Nil	Nil	Nil
60	$1.1X10^3$	3.041	Nil	Nil	Nil	Nil
90	$1.8X10^3$	3.255	Nil	Nil	Nil	Nil
120	$2.2X10^3$	3.342	Nil	Nil	Nil	Nil
150	$3.4X10^3$	3.531	Nil	Nil	Nil	Nil
180	$5.5X10^3$	3.740	Nil	Nil	Nil	Nil
210	$6.6X10^3$	3.819	Nil	Nil	Nil	Nil

Nil=No viable count

Table (63): Effect of gamma irradiation on Streptococcus spp bacterial count of Dry Fish (wazaf), during storage at roomtemperature.

Dose (KGY)	0.0		1.5		3.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	5.4X10	1.732	Nil	Nil	Nil	Nil
30	7.2X10	1.857	Nil	Nil	Nil	Nil
60	$1.1X10^2$	2.041	Nil	Nil	Nil	Nil
90	$2.2X10^2$	2.342	Nil	Nil	Nil	Nil
120	$2.5X10^2$	2.397	Nil	Nil	Nil	Nil
150	$3.4X10^2$	3.531	Nil	Nil	Nil	Nil
180	$5.8X10^2$	3.763	Nil	Nil	Nil	Nil
210	$7.0X10^2$	3.845	Nil	Nil	Nil	Nil

Nil=No viable count

these members were among the organisms flora of dry fish, recovered before irradiation, but in relatively small numbers. (ables 56-63) ranged from 1.0 C.F.U/g to 5.1 x 10^2 C.F.U/g. As well as the effect of gamma irradiation and storage at room temperature on the total previous members counts of dry fish determined in same tables. The data showed that the use of gamma irradiation with dose level 1.5 KGY almost inhibited the few cells of these member organisms that were present in dry fish samples before irradiation and don't detected in any irradiated samples.

The same result was found by ***Kramontong and Fouly (1981); and Hammad (1985)***, for semi dried bolti fish, and ***Shawki (1998);*** for crap fish.

Meanwhile the total count of these microorganisms in unirradiated samples slightly increased during storage at room temperature (for 210 days), the total count slightly increased with the time of storage increasing. All previous results were similar with ***Ingram and Simonsen (1980); Khallaf (1982); El-Mongy (1990); Hoda (1994); Hammad (1996); Shawki (1998);and Afif and El-Nashaby (2001).***

4-6-Effect of gamma irradiation and storage at room temperature on chemical composition of Cinnamon, Cloves and Cardamom.

(1) Moisture content:

The chemical constituents of these spices which were collected from the [R. of Yemen (Taize)] retails are given in the following tables. It is clear form these results that the composition of all type spices (under investigation) were in agreement of the. Arabian and Egyptian legal standards.

The variation of the chemical composition between the different spices under study could be attributed to the difference of the types, varieties environments and storage conditions.

The changes in moisture content of cinnamon, cloves and cardamom as effected by gamma irradiation at doses 2.5 and 5.0 KGY and storage at room temperature for 210 days (7 months) are showen in tables (64, 65 and 66) that the moisture contents of cinnamon, cloves and cardamom at zero time (for control) were 11.422, 9.932 and 11.280% respectively. These results agree with ***Leung and Foster (1996); Newals et al (1998); and Mhamod (1999).***

Also, it is obvious from the same tables that gamma irradiation doses under taken (2.5 and 5 KGY) had no real effect on moisture content of cinnamon, cloves and cardamom, where the moisture content of irradiated samples at doses, 2.5 and 5.0 KGY was 11.331 and 11.151% of cinnamon, while was 9.800 and 9.692% of cloves and was 11.21 and 11.10% of cardamom respectively.

These results are in agreement with those obtained ***Ratnagake (1991); Piggott and Othman (1993); El-Khawas (1995); Leung and Foster (1996); and Newal et al (1998).***

The same tables indicated that the moisture content showed slight decrease during storage of the samples under investigation at room temperature, the moisture content of samples after 210 days of storage of treated samples at 0.0, 2.5 and 5.0 KGY was 10.32, 10.25 and 10.18% of cinnamon mean while was 8.890, 8.0851 and 8.734%

Table (64): Effect of gamma irradiation on moisture content of Cinnamon, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	11.422	0.000	11.331	0.000	11.151	0.000
30	11.262	-1.400	11.175	-1.376	11.011	-1.255
60	11.105	-2.775	11.021	-2.735	10.872	-2.502
90	10.948	-4.149	10.867	-4.594	10.734	-3.739
120	10.791	-5.524	10.712	-5.462	10.595	-4.986
150	10.634	-6.898	10.558	-6.821	10.457	-6.223
180	10.477	-8.273	10.404	-8.181	10.318	-7.470
210	10.320	-9.648	10.250	-9.540	10.180	-8.707

Table (65): Effect of gamma irradiation on moisture content of Cloves, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	9.932	0.000	9.800	0.000	9.692	0.000
30	9.783	-1.500	9.650	-1.530	9.540	-1.568
60	9.634	-3.000	9.500	-3.061	9.589	-1.627
90	9.485	-4.500	9.350	-4.591	9.438	-2.620
120	9.336	-6.000	9.400	-4.081	9.283	-4.219
150	9.187	-7.501	9.250	-5.612	9.136	-5.736
180	9.038	-9.001	9.088	-7.265	8.989	-7.253
210	8.890	-10.491	8.851	-9.683	8.734	-9.884

Table (66): Effect of gamma irradiation on moisture content of cardamom, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	11.280	0.000	11.210	0.000	11.100	0.000
30	11.124	-1.382	11.058	-1.355	10.951	-1.342
60	10.962	-2.765	10.907	-2.702	10.802	-2.684
90	10.812	-4.148	10.755	-4.058	10.654	-4.018
120	10.657	-5.523	10.604	-5.405	10.505	-5.360
150	10.501	-6.906	10.452	-6.761	10.357	-6.693
180	10.345	-8.289	10.301	-8.108	10.208	-8.036
210	10.190	-9.663	10.150	-9.455	10.060	-9.369

of cloves and was 10.19, 10.15 and 10.06% of cardamom, respectively. These results agreed with those obtained by ***Obied (1987); Sadao et al (1988); El-Khawas (1995),*** and ***Leung*** and ***Foster (1996).*** This decrease due to the effect of temperature of storage which caused evaporation of water content of samples during storage and become more deried.

(2) protein content:

Tables (67, 68 and 69) show that the effect of gamma irradiation (2.5 and 5.0 KGY) on the total protein content of cinnamon, cloves and cardamom during storage at room temperature.

Form same tables showe also before storage that unirradated cinnamon, cloves and cardamom samples contained 6.872, 6.241 and 9.370% crud protein at zero time respectively. These results agree with ***Leung and Foster(1996); Newal et at (1998); and Mhamod (1999).*** Gamma ray doses to (2.5 and 5.0 KGY) caused no real changes in protein content of samples under study. However the protein content of cinnamon samples was 6.97 and 6.65% for irradiated samples at 2.5 and 5.0 KGY, while was 6.195% and 6.102% of cloves and was 9.3 and 9.21% of cardamom samples respectively, as reported by ***El-Khawas (1995), and Newal et al (1998).***

The storage of unirradiated and irradiated cinnamon, cloves and cardamom samples at room temperature (for 210 days) induced slight decreased in their protein content. After 210 days the protein content reached 6.611, 6.551 and 6.44% for unirradiated and irradiated cinnamon samples at 2.5 and 5.0 KGY respectively, while was 5.882, 5.843 and 5.767% of cloves and was 8.990, 8.950 and 8.890% of

Table (67): Effect of gamma irradiation on the total protein content of Cinnamon, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	6.872	0.000	6.790	0.000	6.652	0.000
30	6.825	-0.683	6.753	-0.544	6.629	-0.345
60	6.786	-1.251	6.714	-1.119	6.596	-0.841
90	6.737	-1.964	6.676	-1.678	6.563	-1.337
120	6.696	-2.561	6.637	-2.253	6.530	-1.834
150	6.648	-3.259	6.599	-2.812	6.490	-2.330
180	6.624	-3.608	6.560	-3.387	6.464	-2.826
210	6.611	-3.798	6.551	-3.519	6.440	-3.187

Table (68): Effect of gamma irradiation on the total protein content of Cloves, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	6.241	0.000	6.195	0.000	6.102	0.000
30	6.189	-0.833	6.144	-0.823	6.054	-0.786
60	6.138	-1.650	6.094	-1.630	6.006	-1.573
90	6.089	-2.435	6.044	-2.437	6.959	-2.343
120	6.035	-3.000	6.993	-3.260	5.911	-3.130
150	5.984	-4.117	5.943	-4.067	5.864	-3.900
180	5.983	-4.133	5.893	-4.874	5.816	-4.686
210	5.882	-5.752	5.843	-5.682	5.769	-5.457

Table (69): Effect of gamma irradiation on the total protein content of cardamom, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	9.370	0.000	9.300	0.000	9.210	0.000
30	9.315	-0.586	9.250	-0.537	9.164	-0.499
60	9.261	-1.163	9.200	-1.075	9.118	-0.998
90	9.207	-1.739	9.150	-1.612	9.072	-1.498
120	9.152	-2.326	9.100	-2.150	9.027	-1.986
150	9.098	-2.902	9.050	-2.688	8.981	-2.486
180	9.044	-3.479	9.000	-3.225	8.935	-2.985
210	8.990	-4.055	8.950	-3.763	8.890	-3.474

cardamom samples respectively. Therefor the decrease of protein content of previous samples under study may be due to protein denaturatation as to loss of nirogen besides decomposition of samples under study during storage at room temperature by lower rage of microorganisms. Similar observation were obtained by ***El-Khawas (1995), Leung and Foster (1996), and Newal et al (1998).***

(3) Fat content:

Data present in tables (70, 71 and 72) illustrated the fat content changes of cinnamon, cloves and cardamom induced by room temperature storage for 210 days and gamma irradiation (at 2.5 and 5.0 KGY).

The results indicated that gamma irradiation doses under taken (2.5 and 5.0 KGY) had no real effect on fat content of previous samples under study. This result agree with ***Nobutada et al (1991), Ratnagake (1991); Piggott and Othman (1993); and El-Khawas (1995).***

At zero time Before storage the fat content for control sample and samples irradiated at 2.5 and 5.0 KGY were 0.311 and 0.301 and 0.272% of cinnamon samples (Table 70) respectively, while were 0.631, 0.622 and 0.601% of cloves (Table 71) and were 0.370, 0.360 and 0.330% of cardamom samples (Table 72), respectively. Similar results were obtained by ***El-Khawas (1995); Leung and Foster (1996); Newal et al (1998); and Mhamod (1999).***

In addition, after storage at room temperature (for 210 days) the fat content for the same previous samples under study reached 0.272, 0.255 and 0.239% for control and irradiated (2.5, 50 KGY) cinnamon

Table (70): Effect of gamma irradiation on the fat content of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	0.311	0.000	0.3.01	0.000	0.272	0.000
30	0.298	-4.180	0.307	1.993	0.281	3.308
60	0.285	-8.360	0.294	-2.325	0.272	0.000
90	0.292	-6.109	0.286	-4.983	0.265	-2.573
120	0.300	-3.536	0.279	-7.308	0.256	-5.882
150	0.287	-7.717	0.268	-10.963	0.248	-8.823
180	0.284	-8.681	0.260	-13.621	0.248	-8.823
210	0.272	-12.540	0.255	-15.282	0.239	-12.132

Table (71): Effect of gamma irradiation on the fat content of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	0.631	0.000	0.622	0.000	0.601	0.000
30	0.618	-2.060	0.613	-1.446	0.590	-1.830
60	0.606	-3.961	0.598	-3.858	0.580	-3.494
90	0.598	-5.229	0.588	-5.466	0.570	-5.158
120	0.587	-6.973	0.594	-4.501	0.559	-6.988
150	0.568	-9.984	0.569	-8.520	0.549	-8.652
180	0.596	-5.546	0.590	-5.144	0.539	-10.316
210	0.564	-10.618	0.588	-5.466	0.529	-11.980

Table (72): Effect of gamma irradiation on the fat content of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	0.370	0.000	0.360	0.000	0.330	0.000
30	0.357	-3.513	0.347	-3.611	0.318	-3.636
60	0.344	-7.027	0.334	-7.222	0.307	-6.969
90	0.331	-10.540	0.321	-10.833	0.295	-10.606
120	0.318	-14.054	0.308	-14.444	0.284	-13.939
150	0.305	-17.567	0.295	-18.055	0.272	-17.575
180	0.292	-21.081	0.282	-21.166	0.261	-20.909
210	0.280	-24.324	0.270	-25.000	0.250	-24.242

samples (Table 70) respectively, while reached 0.564, 0.588 and 0.529% of cloves (Table 71) and reached 0.280, 0.270 and 0.250% of cardamom samples (Table 72) respectively. It is clear the fat content of the ascending spices samples slightly decreased during storage at room temperature and this decrease due to oxidation by microorganisms leading to the conversion of part of lipids.

This result agree with Obied (1987); Sadao et al (1988); and El-Khawas (1995).

(4) Ash content:

It is obvious from the data obtained in tables (73, 74, and 75) that Ash content of unirradiated and irradiated, cinnamon, cloves and cardamom samples before and after storage at room temperature (for 210 days) was the same (No changes). Therefore the gamma irradiation doses (2.5 and 5.0 KGY) and storage at room temperature for 210 days had no effected on ash content of samples under investigation (Cinnamon, Cloves and Cardamom). The results agree with those obtained by ***Obied (1987), Hoda (1994), El-Khawas (1995), and Mhamod (1999).***

4-7- Effect of gamma irradiation and storage at room temperature on the microbial aspects of Cinnamon, Cloves and Cardamom.

Since total microbial count of any spices is correlated directly with its hygienic conditions during processing, handling, trans protion, and storage conditions. ***(Mhamod 1999).***

The shelf-life of any dry food was found to be dependent up on initial microbial count, storage temperature and any technological

Table (73): Effect of gamma irradiation on the ash content of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	5.501	0.000	5.491	0.000	5.480	0.000
30	5.501	0.000	5.491	0.000	5.480	0.000
60	5.500	-0.018	5.492	0.018	5.481	0.018
90	5.501	0.000	5.490	-0.018	5.479	-0.018
120	5.506	0.090	5.491	0.000	5.479	-0.018
150	5.505	0.072	5.491	0.000	5.480	0.000
180	5.504	0.054	5.489	-0.036	5.480	0.000
210	5.502	0.018	5.491	0.000	5.485	0.091

Table (74): Effect of gamma irradiation on the ash content of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	5.975	0.000	5.894	0.000	5.988	0.000
30	5.975	0.000	5.893	-0.016	5.987	-0.016
60	5.971	-0.066	5.894	0.000	5.987	-0.016
90	5.976	0.016	5.893	0.016	5.988	0.000
120	5.975	0.000	5.893	0.016	5.989	0.016
150	5.969	-0.100	5.894	0.000	5.986	-0.033
180	5.966	-0.016	5.892	-0.033	5.988	0.000
210	5.968	-0.117	5.894	0.000	5.987	-0.016

Table (75): Effect of gamma irradiation on the ash content of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	9.000	0.000	8.990	0.000	8.970	0.000
30	8.998	-0.022	8.988	-0.022	8.970	0.000
60	8.999	-0.011	8.990	0.000	8.972	0.022
90	9.000	0.000	8.991	0.011	8.969	-0.011
120	9.000	0.000	8.991	0.011	8.980	0.111
150	8.999	-0.011	8.990	0.000	8.969	-0.011
180	8.998	-0.022	8.987	-0.033	8.970	0.000
210	9.000	0.000	8.988	-0.022	8.970	0.000

treatment can be effectively used to eliminate the microorganisms (e.g irradiation dose treatment) B.M.A (1989), and Afifi and EL-Nashaby (2001). The obtained spices samples mentioned above were examined for the total counts of the following microorganisms.

(1) Total Aerobic bacterial count:

The results in tables (76, 77 and 78) and indicate that the effect of gamma irradiation and storage at room temperature for 210 days on the total Aerobic bacterial counts of cinnamon, cloves and cardamom. It is obvious from the same tables that the previous three spices had total Aerobic bacterial count at zero time of control samples were 2.4 x 10^3 C.F.U/g for cinnamon samples, 1.2 x 10^2 C.F.U/g for cloves sample and 3.8 x 10^2 C.F.U/g for cardamom samples. This value is within the range of values of cinnamon, cloves and cardamom as reported by ***Obied (1987), El-Khawas (1995) and Mhamod (1999).***

However the total Aerobic bacterial count of unirradiated and irradiated cinnamon, loves, and cardamom samples at zero time were 2.4 x 10^3, 6.1 x 10^2, and 9.5 C.F.U/g for cinnamon sample while were 1.2 x 10^2, 1.8 x 10 and 2.6 C.F.U/g for cloves and were 3.8 x 10^2, 3.9 x 10 and 8.0 C.F.U/g for cardamom sample when treated at (0.0, 2.5, and 5.0 KGY) respectively. On the other hand, the application of 2.5 and 5.0 KGY gamma irradiation dose decreased the total aerobic bacterial count by about 75 and 99.6% from the intial count in the cinnamon sample while 85 and 97.8% in the cloves samples and by about 89.7 and 97.89% in the cardamom samples respectively. There for the decrease in the total aerobic baterial count was linearly as a function of radiation dose in all types of previous tested spices. Similar finding were reported by many works such as ***Sharma et al***

Table (76): Effect of gamma irradiation on total aerobic bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$2.4X10^3$	3.380	$6.1X10^2$	2.113	9.5	0.977
30	$3.1X10^3$	3.491	$2.0X10^2$	2.301	1.17X10	1.068
60	$4.0X10^3$	3.602	$2.9X10^2$	2.462	1.6X10	1.204
90	$6.3X10^3$	3.993	$3.5X10^2$	2.544	2.2X10	1.342
120	$1.3X10^4$	4.113	$6.0X10^2$	2.778	3.0X10	1.477
150	$1.8X10^4$	4.255	$6.8X10^2$	2.832	3.5X10	1.544
180	$2.0X10^4$	4.301	$8.4X10^2$	2.924	4.8X10	1.662
210	$4.0X10^4$	4.623	$1.0X10^3$	3.000	6.0X10	1.778

Table (77): Effect of gamma irradiation on total aerobic bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	**Count / g**	**Log**	**Count / g**	**Log**	**Count / g**	**Log**
0	1.2×10^2	2.079	1.8×10	1.255	2.6	0.414
30	1.8×10^2	2.255	2.4×10	1.380	3.6	0.556
60	2.5×10^2	2.397	3.0×10	1.477	5.2	0.716
90	3.9×10^2	2.591	4.4×10	1.643	7.8	0.892
120	5.2×10^2	2.716	5.4×10	1.732	1.0×10	1.000
150	7.4×10^2	2.869	8.1×10	1.908	1.7×10	1.230
180	1.1×10^3	3.041	1.0×10^2	2.000	2.2×10	1.342
210	1.9×10^3	3.278	1.7×10^2	2.230	3.4×10	1.531

Table (78) : Effect of gamma irradiation on total aerobic bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.8×10^2	2.579	3.9×10	1.591	8.0	0.903
30	5.9×10^2	2.770	4.9×10	1.690	1.1×10	1.041
60	9.0×10^2	2.954	6.6×10	1.819	1.5×10	1.176
90	1.5×10^3	3.176	8.8×10	1.944	1.9×10	1.278
120	2.4×10^3	3.380	1.4×10^2	2.146	2.7×10	1.431
150	3.4×10^3	3.531	1.7×10^2	2.230	3.3×10	1.518
180	6.0×10^3	3.778	2.3×10^2	2.361	4.6×10	1.662
210	9.8×10^3	3.991	3.1×10^2	2.491	7.0×10	1.845

(1984); Hammad et al (1987); Makoto et at (1989); and El-khawas (1995).

In addition the total Aerobic bacterial counts of irradiated and control cinnamon, cloves and cardamom samples stored at room temperature for 210 days are slight in creased to reached 4.0×10^4, 1.0×10^3 and 6.0x 10 C.F.U/g for control and irradiated cinnamon (to 2.5 and 5.0 KGY) respectively, men while reached to 1.9×10^3, 1.7×10^2 and 3.4 x 10 C.F.U/g for control and irradiated cloves to (2.5 and 5.0 KGy) and reached to 9.8×10^3, 3.1×10^2 and 7.0 x 10 C.F.U/g for control and irradiated cardamom samples at (2.5 and 5.0 KGY) respectively. This results agree with El-Khawas (1995) and Te-Giffel et at (1997).

(2) Total Anaerobic bacterial count:

Tables (79, 80 and 81) and demonstrated that the in fluence of gamma irradiation at different doses (2.5, 5.0 KGY), on the Anaerobic bacterial counts associated with species under study (Cinnamon, Cloves and Cardamom) during storage at room temperature for 210 days. The results in same tables and. Show the treatment with gamma irradiation before storage reduced the count of Anaerobic organisms from 5.3 x 10 C.F.U/g for the control cinnamon sample to 2.0 x 10 and 7.0 C.F.U/g after exposin cinnamon samples to 2.5 and 5.0 KGY respectively, while from 9.0 C.F.U/g for the control cloves sample to 5.0 and 2.1 C.F.U/g after exposin to 2.5 and 5.0 KGY and from 1.1 x 10 to 4.0 and 2.0 C.F.U/g for the control and after exposin cardamom samples to 2.5 and 5.0 KGY respectively.

As well as the total Anaerobic bacterial counts slightly increased in unirradiated and irradiated cinnamom, cloves and

Table (81) : Effect of gamma irradiation on total anaerobic bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1 × 10	1.041	4.0	0.602	2.0	0.301
30	1.3 × 10	1.113	6.2	0.792	3.0	0.477
60	1.6 × 10	1.204	8.1	0.908	3.2	0.505
90	1.9 × 10	1.278	1.1 × 10	1.040	4.0	0.602
120	2.2 × 10	1.342	1.1 × 10	1.040	4.6	0.662
150	2.8 × 10	1.447	1.4 × 10	1.146	5.1	0.707
180	3.5 × 10	1.544	1.4 × 10	1.146	5.9	0.770
210	4.4 × 10	1.732	1.9 × 10	1.278	7.7	0.886

cardamom samples during storage at room temperature for 210 days to reached 1.4 x 10, 4.0 x 10 and 1.2 x 10 C.F.U/g for unirradiated and irradiated (at 2.5 and 5.0 KGY) cinnamon samples respectively, while reached 4.0 x 10, 1.5 x 10 and 5.2 C.F.U/g for unirradiated and irradiated to 2.5 and 5.0 KGY cloves samples respectively, menwhile reached 4.4 x 10, 1.9 x 10 and 7.7 C.F.U/g for unirradaited and irradiated cardamom samples for ascending doses respectively. This results agree with ***Ratnagake (1991), and Piggott and Othman (1993).***

(3) Total Sporeform bacterial count:

Data personated in table (82, 83 and 84) and illustrated showed that the average counts of Sporeforming bacteria in cinnamon, cloves and cardamom samples as affected by gamma irradiation at (2.5 and 5.0 KGY) and subsequent room temperature storage for 210 days. From same tables and figs, the results indicated that Sporeformer organisms were the most resistant type to irradiation, that even at dose level of 5.0 KGY considerable numbers were still recoverd, due probably to their low water content. ***[El-Mongy (1990)]***. Inaddition During storage at room temperature for 210 days, their total spore form numbers slightly increased at relatively slow rate for all unirradiated and irradiated under study samples. These results emphasized the finding of ***Baxter and Holzapfel (1982)***; ***Labai et al (1985); Kaur (1986); Obied (1987); and El-Mongy (1990).***

(4) Total Bacillus spp bacterial count:

The data recorded in tables (85, 86 and 87) and show the effect of different gamma irradiation doses on <u>Bacillus</u> <u>spp</u> counts of cinnamon, cloves and cardamom during storage at room temperature

Table (82): Effect of gamma irradiation on sporeform bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	6.0X10	1.778	2.0X10	1.301	8.5	0.929
30	7.2X10	1.857	2.2X10	1.342	9.0	0.954
60	8.5X10	1.929	3.0X10	1.477	9.9	0.995
90	$1.0X10^2$	2.000	3.3X10	1.518	1.3 X10	1.113
120	$1.3X10^2$	2.113	3.8X10	1.579	1.5 X10	1.176
150	$1.6X10^2$	2.204	4.5X10	1.653	1.7 X10	1.230
180	$1.9X10^2$	2.278	5.7X10	1.755	1.9X10	1.278
210	$2.4X10^2$	2.380	6.6X10	1.819	2.2X10	1.342

Table (83) : Effect of gamma irradiation on spore form bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	9.0	0.954	6.0	0.778	3.9	0.591
30	1.23 × 10	1.089	7.7	0.886	4.4	0.643
60	1.7 × 10	1.230	1.0 × 10	1.000	5.1	0.707
90	2.5 × 10	1.397	1.4 × 10	1.146	5.9	0.770
120	3.3 × 10	1.518	1.8 × 10	1.255	6.6	0.819
150	4.2 × 10	1.623	2.2 × 10	1.342	7.3	0.863
180	5.9 × 10	1.770	2.9 × 10	1.462	8.6	0.934
210	8.0 × 10	1.903	3.7 × 10	1.568	9.9	0.995

Table (84) : Effect of gamma irradiation on spore form bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.2×10	1.079	6.0	0.778	2.9	0.462
30	1.8×10	1.255	9.0	0.954	3.7	0.568
60	2.6×10	1.414	1.2×10	1.079	5.5	0.740
90	4.2×10	1.623	1.8×10	1.255	7.0	0.845
120	7.3×10	1.863	2.6×10	1.414	9.0	0.954
150	9.9×10	1.995	3.9×10	1.591	1.3×10	1.113
180	1.5×10^2	2.176	4.8×10	1.681	1.9×10	1.278
210	2.4×10^2	2.380	5.5×10	1.740	2.3×10	1.361

for 210 days, the results in dictated that Bacillus spp organisms were the resistant type to irradiation, But the microbial numbers density of Bacillus spp slightly decreased with the irradiation dose increasing.

Moreover form same table that the total Bacillus spp counts at zero time of cinnamon was 1.1 x 10, 5.6 and 3.1 C.F.U/g when exposed to (0.0, 2.5 and 5.0 KGY) respectively, while was 3.4, 2.0 and 1.4 C.F.U/g for cloves samples when exposed to (0.0, 25, and 5.0 KGY) respectively, men while was 5.0, 2.0 and 1.8 C.F.U/g for cardamom sample at ascending doses respectively.

As well as the total Bacillus spp count of unirradiated and irradiated (to 2.5 and 5.0 KGY) under taken samples slightly increased during storage at room temperature for 210 days reached to 5.8 x 10, 3.5 x 10 and 8.0 C.F.U/g for cinnamom samples while reached 1.1x10, 5.2 and 2.9 C.F.U/g for cloves samples and reached to 2.0 x 10, 9.8 and 4.6 C.F.U/g for cardamom samples which exposed to 0.0, 2.5 and 5.0 KGY, gamma irradiation doses respectively. These results agree with ***Beuchat and Ann Maline (1980); Johnson et at (1982); Kaur (1986); and Obied (1987).***

(5) Total pathogenic bacterial count:

Generally, spices are susceptible to contaminate by various types of microorganisms in clouding, the pathogenic microorganisms, the main sources of microbial contamination in spices are, water, soil, dust, air, transportion and marketing conditions. Radiation can be used in the food industry to sterilize spices. Consequently, a set of experiments was conducted to elucidate the effect of gamma irradiation on the total viable counts, specially the pathogenic microorganism of the spices under study. Data in tables (88-111)

Table (85): Effect of gamma irradiation on Bacillus spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1X10	1.041	5.6	0.748	3.1	0.491
30	1.6X10	1.146	7.0	0.845	3.1	0.491
60	1.8X10	1.255	9.4	0.973	3.5	0.544
90	2.2X10	1.342	1.3X10	1.113	4.1	0.612
120	2.8X10	1.447	1.6X10	1.204	4.9	0.690
150	3.4X10	1.531	2.2X10	1.342	5.7	0.755
180	4.7X10	1.672	2.8X10	1.447	6.8	0.832
210	5.8X10	1.763	3.5X10	1.544	8.0	0.903

Table (86): Effect of gamma irradiation on Bacillus spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.4	0.531	2.0	0.301	1.4	0.146
30	4.0	0.602	2.3	0.361	1.54	0.187
60	4.7	0.672	2.8	0.447	1.7	0.230
90	5.5	0.740	3.0	0.477	1.9	0.278
120	6.6	0.819	3.4	0.531	2.1	0.322
150	7.8	0.892	3.9	0.591	2.4	0.380
180	9.2	0.963	4.4	0.643	2.6	0.414
210	1.1 × 10	1.041	5.2	0.716	2.9	0.462

Table (87) : Effect of gamma irradiation on Bacillus spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	5.0	0.698	2.0	0.477	1.8	0.255
30	6.1	0.785	3.6	0.556	2.0	0.301
60	7.2	0.857	4.0	0.602	2.4	0.380
90	8.4	0.924	4.9	0.690	2.7	0.431
120	1.2 × 10	1.079	5.5	0.740	2.9	0.483
150	1.4 × 10	1.146	6.7	0.826	3.2	0.505
180	1.7 × 10	1.230	8.0	0.903	3.8	0.579
210	2.0 × 10	1.301	9.8	0.991	4.6	0.662

revealed that the pathogenic bacteria under investigation are Yeast and Moulds (Tables 88-90), Clostridium spp (Tables 91-93), Enteriobacteriaceae (Tables 94-96). Enterorcocci spp (Tables 97-99), Coliform group (Tables 100-102), Salmonella spp (Tables 103-105), Staphylococcus spp (Tables 106-108), and Streptococcus spp (Tables 109-111). From same tables showed that the total counts of previous pathogenic bacteria induced by gamma irradiation at (2.5 and 5.0 KGY) and room temperature storage for 210 days of cinnamon, cloves and cardamom. However the previous members organism were among the bacterial flora of spices, recovered before treatment with irradiation doses, but in relatively small numbers, ranged from 1.1 C.F.U/g to 4.2 x 10 organisms/g (Tables 88-111). These results are in agreement with ***Schwab et at (1982), and Labai et at (1985).***

In addition it is clear from same tables (88-111) that the gamma irradiation with dose level of 2.5 KGY destroyed all the few cells of these organisms that present in the samples before irradiation, inaddition that they were not recovered any viable cells from the irradiated cinnamon, cloves and cardamom samples, also that 5.0 KGY are quite enough to eliminate these pathogenic organisms.

This coincides with the finding of ***Hammad et at (1987); Munasiri et at (1987); El-Gedawy et at (1988); Singh et at (1988); and Makoto et at (1989).***

Moreover the total pathogenic bacterial counts of cinnamon, cloves and cardamom samples slightly increased during storage at room temperature for 210 days this sight increased in total pathogenic bacterial counts could be due to the effect of air temperature on condition of storage at room temperature that caused to this slight

Table (88): Effect of gamma irradiation on yeast and mould count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.2X10	1.623	Nil	Nil	Nil	Nil
30	7.0X10	1.845	Nil	Nil	Nil	Nil
60	9.9X10	1.995	Nil	Nil	Nil	Nil
90	$1.8X10^2$	2.255	Nil	Nil	Nil	Nil
120	$2.8X10^2$	2.447	Nil	Nil	Nil	Nil
150	$5.0X10^2$	2.698	Nil	Nil	Nil	Nil
180	$8.8X10^2$	2.944	Nil	Nil	Nil	Nil
210	$1.7X10^3$	3.230	Nil	Nil	Nil	Nil

Table (89): Effect of gamma irradiation on yeast and mould count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.9	0.591	NIL	NIL	NIL	NIL
30	4.4	0.643	NIL	NIL	NIL	NIL
60	5.2	0.716	NIL	NIL	NIL	NIL
90	5.8	0.763	NIL	NIL	NIL	NIL
120	6.9	0.838	NIL	NIL	NIL	NIL
150	7.7	0.886	NIL	NIL	NIL	NIL
180	8.6	0.934	NIL	NIL	NIL	NIL
210	9.9	0.995	NIL	NIL	NIL	NIL

Nil=No viable count

Table (90) : Effect of gamma irradiation on yeast and mould count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	7.0	0.845	NIL	NIL	NIL	NIL
30	8.3	0.919	NIL	NIL	NIL	NIL
60	9.9	0.995	NIL	NIL	NIL	NIL
90	1.5 × 10	1.176	NIL	NIL	NIL	NIL
120	2.0 × 10	1.301	NIL	NIL	NIL	NIL
150	2.6 × 10	1.414	NIL	NIL	NIL	NIL
180	3.4 × 10	1.531	NIL	NIL	NIL	NIL
210	4.4 × 10	1.643	NIL	NIL	NIL	NIL

Nil=No viable count

Table (91): Effect of gamma irradiation on Clostridium spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.0	0.301	Nil	Nil	Nil	Nil
30	2.2	0.342	Nil	Nil	Nil	Nil
60	2.5	0.397	Nil	Nil	Nil	Nil
90	2.5	0.397	Nil	Nil	Nil	Nil
120	2.6	0.414	Nil	Nil	Nil	Nil
150	2.9	0.462	Nil	Nil	Nil	Nil
180	2.9	0.462	Nil	Nil	Nil	Nil
210	3.2	0.505	Nil	Nil	Nil	Nil

Nil=No viable count

Table (92) : Effect of gamma irradiation on Clostridium spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1	0.041	NIL	NIL	NIL	NIL
30	1.3	0.113	NIL	NIL	NIL	NIL
60	1.5	0.176	NIL	NIL	NIL	NIL
90	1.8	0.255	NIL	NIL	NIL	NIL
120	2.1	0.322	NIL	NIL	NIL	NIL
150	2.5	0.397	NIL	NIL	NIL	NIL
180	2.9	0.462	NIL	NIL	NIL	NIL
210	3.5	0.544	NIL	NIL	NIL	NIL

Nil=No viable count

Table (93) : Effect of gamma irradiation on Clostridium spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.3	0.113	NIL	NIL	NIL	NIL
30	1.5	0.176	NIL	NIL	NIL	NIL
60	1.9	0.278	NIL	NIL	NIL	NIL
90	2.2	0.342	NIL	NIL	NIL	NIL
120	2.5	0.397	NIL	NIL	NIL	NIL
150	2.9	0.462	NIL	NIL	NIL	NIL
180	3.8	0.579	NIL	NIL	NIL	NIL
210	4.2	0.623	NIL	NIL	NIL	NIL

Nil=No viable count

Table (94): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	8.0	0.903	Nil	Nil	Nil	Nil
30	1.2X10	1.079	Nil	Nil	Nil	Nil
60	1.4X10	1.146	Nil	Nil	Nil	Nil
90	1.74X10	1.240	Nil	Nil	Nil	Nil
120	2.1X10	1.303	Nil	Nil	Nil	Nil
150	2.6X10	1.414	Nil	Nil	Nil	Nil
180	3.2X10	1.505	Nil	Nil	Nil	Nil
210	4.4X10	1.643	Nil	Nil	Nil	Nil

Nil=No viable count

Table (95) : Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.0	0.477	NIL	NIL	NIL	NIL
30	4.2	0.623	NIL	NIL	NIL	NIL
60	6.3	0.799	NIL	NIL	NIL	NIL
90	8.8	0.944	NIL	NIL	NIL	NIL
120	1.1 × 10	1.146	NIL	NIL	NIL	NIL
150	1.9 × 10	1.278	NIL	NIL	NIL	NIL
180	2.7 × 10	1.431	NIL	NIL	NIL	NIL
210	3.9 × 10	1.591	NIL	NIL	NIL	NIL

Nil=No viable count

Table (96) : Effect of gamma irradiation on Enteriobacteriaceae bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	5.0	0.698	NIL	NIL	NIL	NIL
30	7.3	0.863	NIL	NIL	NIL	NIL
60	1.2 × 10	1.079	NIL	NIL	NIL	NIL
90	1.9 × 10	1.278	NIL	NIL	NIL	NIL
120	2.4 × 10	1.380	NIL	NIL	NIL	NIL
150	4.6 × 10	1.556	NIL	NIL	NIL	NIL
180	5.2 × 10	1.716	NIL	NIL	NIL	NIL
210	7.7 × 10	1.886	NIL	NIL	NIL	NIL

Nil=No viable count

Table (97): Effect of gamma irradiation on Enterococcci spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	6.0	0.778	Nil	Nil	Nil	Nil
30	7.8	0.892	Nil	Nil	Nil	Nil
60	1.0X10	1.000	Nil	Nil	Nil	Nil
90	1.4X10	1.146	Nil	Nil	Nil	Nil
120	1.8X10	1.255	Nil	Nil	Nil	Nil
150	2.2X10	1.340	Nil	Nil	Nil	Nil
180	2.6X10	1.414	Nil	Nil	Nil	Nil
210	3.8X10	1.579	Nil	Nil	Nil	Nil

Nil=No viable count

Table (98) : Effect of gamma irradiation on Enterocococci spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.0	0.602	NIL	NIL	NIL	NIL
30	5.7	0.755	NIL	NIL	NIL	NIL
60	8.2	0.913	NIL	NIL	NIL	NIL
90	1.22 × 10	1.086	NIL	NIL	NIL	NIL
120	1.7 × 10	1.230	NIL	NIL	NIL	NIL
150	2.4 × 10	1.380	NIL	NIL	NIL	NIL
180	3.6 × 10	1.556	NIL	NIL	NIL	NIL
210	5.8 × 10	1.763	NIL	NIL	NIL	NIL

Nil=No viable count

Table (99) : Effect of gamma irradiation on Enterocococci spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	7.1	0.851	NIL	NIL	NIL	NIL
30	1.0 × 10	1.000	NIL	NIL	NIL	NIL
60	1.4 × 10	1.146	NIL	NIL	NIL	NIL
90	2.2 × 10	1.342	NIL	NIL	NIL	NIL
120	2.9 × 10	1.462	NIL	NIL	NIL	NIL
150	4.0 × 10	1.602	NIL	NIL	NIL	NIL
180	5.6 × 10	1.748	NIL	NIL	NIL	NIL
210	8.0 × 10	1.903	NIL	NIL	NIL	NIL

Nil=No viable count

Table (100): Effect of gamma irradiation on coliform group bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.0	0.602	Nil	Nil	Nil	Nil
30	5.5	0.740	Nil	Nil	Nil	Nil
60	7.1	0.851	Nil	Nil	Nil	Nil
90	9.2X10	1.963	Nil	Nil	Nil	Nil
120	1.3X10	1.113	Nil	Nil	Nil	Nil
150	1.7X10	1.230	Nil	Nil	Nil	Nil
180	2.2X10	1.342	Nil	Nil	Nil	Nil
210	3.2X10	1.505	Nil	Nil	Nil	Nil

Nil=No viable count

Table (101): Effect of gamma irradiation on coliform group bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.0	0.301	NIL	NIL	NIL	NIL
30	2.9	0.462	NIL	NIL	NIL	NIL
60	4.4	0.643	NIL	NIL	NIL	NIL
90	6.6	0.819	NIL	NIL	NIL	NIL
120	6.1	0.785	NIL	NIL	NIL	NIL
150	1.5 × 10	1.176	NIL	NIL	NIL	NIL
180	2.2 × 10	1.342	NIL	NIL	NIL	NIL
210	3.3 × 10	1.518	NIL	NIL	NIL	NIL

Nil=No viable count

Table (102) : Effect of gamma irradiation on coliform group bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.5	0.176	NIL	NIL	NIL	NIL
30	2.6	0.414	NIL	NIL	NIL	NIL
60	4.1	0.612	NIL	NIL	NIL	NIL
90	6.3	0.799	NIL	NIL	NIL	NIL
120	7.7	0.886	NIL	NIL	NIL	NIL
150	2.0 × 10	1.301	NIL	NIL	NIL	NIL
180	3.5 × 10	1.544	NIL	NIL	NIL	NIL
210	4.6 × 10	1.662	NIL	NIL	NIL	NIL

Nil=No viable count

Table (103): Effect of gamma irradiation on Salmonella spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.0	0.301	Nil	Nil	Nil	Nil
30	2.5	0.397	Nil	Nil	Nil	Nil
60	3.0	0.477	Nil	Nil	Nil	Nil
90	3.3	0.518	Nil	Nil	Nil	Nil
120	3.9	0.591	Nil	Nil	Nil	Nil
150	4.4	0.643	Nil	Nil	Nil	Nil
180	5.1	0.707	Nil	Nil	Nil	Nil
210	6.4	0.806	Nil	Nil	Nil	Nil

Nil=No viable count

Table (104) : Effect of gamma irradiation on Salmonella spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1	0.041	NIL	NIL	NIL	NIL
30	1.39	0.143	NIL	NIL	NIL	NIL
60	1.8	0.255	NIL	NIL	NIL	NIL
90	1.99	0.298	NIL	NIL	NIL	NIL
120	2.4	0.380	NIL	NIL	NIL	NIL
150	3.0	0.477	NIL	NIL	NIL	NIL
180	3.7	0.568	NIL	NIL	NIL	NIL
210	4.4	0.643	NIL	NIL	NIL	NIL

Nil=No viable count

Table (105) : Effect of gamma irradiation on Salmonella spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1	0.041	NIL	NIL	NIL	NIL
30	1.4	0.146	NIL	NIL	NIL	NIL
60	1.8	0.255	NIL	NIL	NIL	NIL
90	2.2	0.342	NIL	NIL	NIL	NIL
120	2.7	0.431	NIL	NIL	NIL	NIL
150	3.3	0.518	NIL	NIL	NIL	NIL
180	4.0	0.602	NIL	NIL	NIL	NIL
210	5.1	0.707	NIL	NIL	NIL	NIL

Nil=No viable count

Table (106): Effect of gamma irradiation on Staphylococcus spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.0	0.477	Nil	Nil	Nil	Nil
30	3.8	0.579	Nil	Nil	Nil	Nil
60	4.4	0.643	Nil	Nil	Nil	Nil
90	5.7	0.755	Nil	Nil	Nil	Nil
120	6.6	0.819	Nil	Nil	Nil	Nil
150	8.0	0.903	Nil	Nil	Nil	Nil
180	9.9	0.995	Nil	Nil	Nil	Nil
210	1.2X10	1.079	Nil	Nil	Nil	Nil

Nil=No viable count

Table (107) : Effect of gamma irradiation on Staphylococcus spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.8	0.447	NIL	NIL	NIL	NIL
30	3.9	0.591	NIL	NIL	NIL	NIL
60	5.5	0.740	NIL	NIL	NIL	NIL
90	7.4	0.869	NIL	NIL	NIL	NIL
120	1.0 × 10	1.000	NIL	NIL	NIL	NIL
150	1.5 × 10	1.176	NIL	NIL	NIL	NIL
180	2.0 × 10	1.301	NIL	NIL	NIL	NIL
210	2.8 × 10	1.447	NIL	NIL	NIL	NIL

Nil=No viable count

Table (108) : Effect of gamma irradiation on Staphylococcus spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.1	0.491	NIL	NIL	NIL	NIL
30	3.9	0.591	NIL	NIL	NIL	NIL
60	4.8	0.681	NIL	NIL	NIL	NIL
90	5.7	0.755	NIL	NIL	NIL	NIL
120	7.2	0.857	NIL	NIL	NIL	NIL
150	8.8	0.944	NIL	NIL	NIL	NIL
180	9.9	0.995	NIL	NIL	NIL	NIL
210	1.5 × 10	1.176	NIL	NIL	NIL	NIL

Nil=No viable count

Table (109): Effect of gamma irradiation on Streptococcus spp bacterial count of Cinnamon during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.1	0.491	Nil	Nil	Nil	Nil
30	3.7	0.568	Nil	Nil	Nil	Nil
60	4.3	0.633	Nil	Nil	Nil	Nil
90	5.1	0.707	Nil	Nil	Nil	Nil
120	5.9	0.770	Nil	Nil	Nil	Nil
150	6.6	0.819	Nil	Nil	Nil	Nil
180	8.0	0.903	Nil	Nil	Nil	Nil
210	9.7	0.986	Nil	Nil	Nil	Nil

Nil=No viable count

Table (110) : Effect of gamma irradiation on Streptococcus spp bacterial count of Cloves during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.2	0.623	NIL	NIL	NIL	NIL
30	5.7	0.755	NIL	NIL	NIL	NIL
60	7.8	0.892	NIL	NIL	NIL	NIL
90	1.1 × 10	1.041	NIL	NIL	NIL	NIL
120	1.4 × 10	1.146	NIL	NIL	NIL	NIL
150	1.9 × 10	1.278	NIL	NIL	NIL	NIL
180	2.5 × 10	1.397	NIL	NIL	NIL	NIL
210	3.6 × 10	1.556	NIL	NIL	NIL	NIL

Nil=No viable count

Table (111) : Effect of gamma irradiation on Streptococcus spp bacterial count of cardamom during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	6.2	0.792	NIL	NIL	NIL	NIL
30	8.0	0.903	NIL	NIL	NIL	NIL
60	1.2 × 10	1.079	NIL	NIL	NIL	NIL
90	1.5 × 10	1.176	NIL	NIL	NIL	NIL
120	1.9 × 10	1.278	NIL	NIL	NIL	NIL
150	2.2 × 10	1.342	NIL	NIL	NIL	NIL
180	3.0 × 10	1.477	NIL	NIL	NIL	NIL
210	3.9 × 10	1.591	NIL	NIL	NIL	NIL

Nil=No viable count

increasing. As mentioned by ***Obied (1987); El-Khawase (1995); and Mhamod (1999).***

4-8- Effect of gamma irradiation and storage at room temperature on the chemical composition of Dry Hot Red Pepper.

(1) Moisture content of pepper:

Table (112) shows the effect of different treatment irradiation doses and storage at room temperature for 210 days on the moisture content of pepper. Form this table it could be seen that the moisture content of the pepper control at zero time and before storage was 6.988% this result within the limits reported for good quality of pepper content. Similar results were obtained by ***Obied (1987); Leung and Foster (1996); and Newal et at (1998).***

Also irradiated pepper. Samples at 2.5 and 5.0 KGY reached to 6.828 and 6.617% respectively. Radiation doses (2.5 and 5.0 KGY) and storage at room temperature for 210 days had no effect on the moisture content of pepper samples as reported by ***Nobutada et at (1991); Ratnagake (1991); Piggott and Othman (1993) and El-Khawas (1995).***

Form same table it could be noticed the moisture content of unirradiated and irradiated pepper samples slight decreased during storage at room temperature reached to 5.698, 4.569 and 4.473%, after 210 days for treated pepper samples at (0.0, 2.5 and 5.0 KGY) this decreased may be due to the small evaporation of moisture form the outer surface of pepper during storage at room temperature.

Table (112): Effect of gamma irradiation on moisture content of Red hot pepper, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	moisture %	Decrease %	moisture %	Decrease %	moisture %	Decrease %
0	6.988	0.000	6.828	0.000	6.617	0.000
30	6.803	-2.647	6.505	-4.730	6.310	-4.639
60	6.619	-5.280	6.182	-9.461	6.004	-9.264
90	6.435	-7.913	5.859	-14.191	5.698	-13.888
120	6.250	-10.560	5.537	-18.907	5.391	-18.528
150	6.066	-13.194	5.214	-23.637	5.085	-23.152
180	5.882	-15.827	4.891	-28.368	4.779	-27.776
210	5.698	-18.460	4.569	-33.084	4.473	-32.401

(2) Protein content of pepper:

The changes in protein contents of unirradiated and irradiated pepper samples throughout the storage at room temperature are shown in table (113), it is obvious from those results that the protein content of unirradiated and irradiated pepper samples at zero time before storage were. 2.799, 2.598 and 2.317% for exposed to 0.0, 2.5 and 5.0 KGY respectively, and during storage at room temperature for 210 days, the protein content of pepper reached to 2.302, 2.155 and 1.934% for the ascending dose respectively. As well as in same table (113) it is obvious that the protein content of pepper samples slightly decreased induced by gamma irradiation and storage at room temperature for 210 days. It is clear that the applied doses of gamma irradiation had no real effects on protein content of pepper the slight decreased may be due to decomposition of tissues pepper by microorganisms during storage at room temperature or used gamma irradiation this results agree with. ***Sadao et al (1988); Nobutada et al (1991); Ratnagake (1991); Piggott and Othman (1993); El Khawase (1995); and Leung and Foster (1996).***

(3) Fat content of pepper:

Effect of gamma irradiation on the fat content of dry pepper during storage at room temperature for 210 days are showen in table (114). That the fat content of pepper in control samples (at zero time) were 0.399% and reached to 0.372 and 0.350%. After irradiation dose to (2.5 and 5.0 KGY) respectively, while the fat content for the same previous samples.

After storage for 210 day at room temperature were 0.367, 0.335 and 0.333% respectively. Inaddition that the gamma irradiation

Table (113): Effect of gamma irradiation on the total protein content of Red hot pepper, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	2.799	0.000	2.598	0.000	2.317	0.000
30	2.728	-2.536	2.534	-2.463	2.262	-2.373
60	2.658	-5.037	2.471	-4.888	2.207	-4.747
90	2.588	-7.538	2.408	-7.313	2.152	-7.121
120	2.518	-10.039	2.344	-9.776	2.098	-9.451
150	2.448	-12.540	2.281	-12.201	2.043	-11.825
180	2.378	-15.041	2.218	-14.626	1.988	-14.199
210	2.302	-17.541	2.155	-17.051	1.934	-16.529

Table (114): Effect of gamma irradiation on the fat content of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	0.399	0.000	0.372	0.000	0.350	0.000
30	0.394	-1.253	0.366	-1.612	0.345	-1.428
60	0.389	-2.506	0.361	-2.956	0.341	-2.571
90	0.385	-3.508	0.356	-4.301	0.339	-3.142
120	0.380	-4.761	0.350	-5.913	0.338	-3.428
150	0.376	-5.764	0.345	-7.258	0.340	-2.857
180	0.371	-7.017	0.340	-8.602	0.339	-3.142
210	0.367	-8.020	0.335	-9.946	0.333	-4.857

doses under testing and storage at room temperature for 210 days, had no effect on the fat content of dry pepper. All previous results agree with ***Obied (1987); Ratanagake (1991); Piggott and Othman (1993); El-Khawase (1995); and Leung and Foster (1996).***

(3) Ash content of pepper:

Table (115) it could be noticed that the changes of ash content on dry pepper during storage at room temperature for 210 days inducted by gamma irradiation (2.5 and 5.0 KGY). From same table (115) showed that the gamma irradiation and room temperature storage for 210 days had no effect on the Ash content of dry pepper, and the data in table (115) indicated that the ash content of unirradiation and irradiated pepper samples before and after storage was the same about (6.6%). This result agree with ***Piggott; Othman (1993); and El-Khawase (1995).***

4-9- Effect of gamma irradiation and storage at room temperature on the microbial aspects of Dry Red Hot Pepper.

It is presumed that the biological effects of radiation are due to chemical changes within the organisms. Absorption of ionizing radiation by microorganisms lead to various chemical changes which may kill or inhibit the growth of micro-organisms. The precise changes lead to inhibition or destruction vary according to the type of micro-organisms, put they generally involve changes in genetic material. ***El-Khawas (1995).***

(1) Total Aerobic bacterial count of pepper:

Most of the bacteria present in pepper owing to the production, transportion, and marketing conditions are probably the sporforming and pathogenic bacteria ***Obied (1987).***

Table (115): Effect of gamma irradiation on the ash content of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	6.697	0.000	6.682	0.000	6.643	0.000
30	6.695	-0.029	6.680	-0.029	6.643	0.000
60	6.700	0.044	6.679	-0.044	6.643	0.000
90	6.693	-0.059	6.688	0.089	6.641	-0.030
120	6.697	0.000	6.677	-0.074	6.639	-0.060
150	6.698	0.014	6.679	-0.044	6.639	0.060
180	6.689	-0.119	6.695	0.194	6.642	-0.015
210	6.697	0.000	6.674	-0.119	6.644	0.015

The results in table (116) show that the initial bacterial count of control Dry Red pepper at zero time and before room temperature storage was 3.1×10^3 C.F.U/g this value is within the range of values of dry pepper as reported by: ***Schwab et at (1982), Shamshed et al (1985); Obied (1987); El-Khawas (1995) and Mhamod (1999).*** The table (116) indicates also that increasing in total bacterial counts of control pepper samples was observed during storage at room temperature for 210 days and reached to 2.0×10^5 C.F.U/g.

This increment in the total bacterial count was higher than another spices under study (cinnamon, cardamom and cloves) and expected as the pepper is considered one of the most perishable spices that is highly susceptible to microbial invasion.

Application of gamma irradiation led to reduction in the micro-organisms of treated pepper samples. Immediately after the radiation process, the total bacterial counts decreased from 3.1×10^3 C.F.U/g in the control sample to 9.8 x 10 and 1.0 x 10 C.F.U/g for exposing pepper samples to 2.5 and 5.0 KGY, respectively.

In other hand the reduction percentages were 96.83 and 99.67% for above-mentioned doses, respectively.

The greatest reduction in the bacterial load is mainly due to the direct and indirect effects of gamma irradiation on the microorganisms and the effects of gamma irradiation as antibacterial agent as reported by. ***Sharma et al (1984); Hammad et al (1987); El- Gedawy et al (1988); Singh et al (1988); Makoto et al (1989); and El-Khawas (1995).***

Moreover from same tables, show that the total bacterial count slightly increased in the irradiated pepper samples by increasing the

Table (116): Effect of gamma irradiation on total aerobic bacterial count of Red hot pepper , during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$3.1X10^3$	3.491	9.8X10	1.991	1.0X10	1.000
30	$3.6X10^3$	3.748	$1.3X10^2$	2.113	2.0X10	1.301
60	$9.4X10^3$	3.973	$2.2X10^2$	2.342	3.4X10	1.531
90	$1.7X10^4$	4.230	$3.8X10^2$	2.579	6.0X10	1.785
120	$2.8X10^4$	4.447	$6.7X10^2$	2.826	7.1X10	1.851
150	$5.1X10^4$	4.707	$1.1X10^3$	3.041	$1.0X10^2$	2.000
180	$8.0X10^4$	4.903	$1.9X10^3$	3.278	$1.7X10^2$	2.230
210	$2.0X10^5$	5.301	$3.2X10^3$	3.505	$2.0X10^2$	2.301

room temperature storage for 210 days and the total bacterial counts reached to 3.2 x 10^3 and 2.0 x 10^2 C.F.U/g for the ascending doses respectively. These results may be due to the effect of room temperature storage treatment these results agree with ***Obied (1987), Subblakshmi et al (1991), Toru et al (1993), El-Khawas (1995), and Mhamod (1999).***

(2) Total Anaerobic bacterial count of pepper:

From table (117) showed the effect gamma irradiation doses and storage at room temperature for 210 days on the log and total Anaerobic bacterial counts of pepper.

From this tables and fingers it could be seen that at zero time, the counts of Anaerobic organisms of control pepper was 7.1 x 10 C.F.U/g and slight increasing during room temperature storage to reached 5.5 x 10^2 after 210 days. From the same table and figs it showed that the count of Anaerobic bacterial counts reduced by treatment with gamma irradiation form 7.1 x 10 C.F.U/g for control samples to 2.6 x 10 and 7.0 C.F.U/g for exposing pepper samples to 2.5 and 5.0 KGY respectively. In addition the data in previous tables and figs showed that the total Anaerobic bacterial count slightly increased in irradiated pepper samples during storage at room temperature for 210 days with increasing the time of storage and the total anaerobic bacterial count of pepper sample reached to 1.6 x 10^2 and 3.8 x 10 C.F.U/g for ascending doses respectively. These results obtained by many investigator ***Obied (1987); El-Shamary (1988); Subblakshmi et al (1991); Toru et al (1993); El-Khawas (1995); and Mhamod (1999).***

Table (117): Effect of gamma irradiation on total anaerobic bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$7.1X10$	1.851	$2.6X10$	1.414	7.0	0.845
30	$8.0X10$	1.903	$3.2X10$	1.505	9.0	0.954
60	$1.3X10^2$	2.113	$4.0X10$	1.602	$1.1X10$	1.041
90	$1.6X10^2$	2.204	$5.3X10$	1.724	$1.4X10$	1.146
120	$2.2X10^2$	2.342	$7.1X10$	1.851	$1.8X10$	1.255
150	$3.1X10^2$	2.491	$9.3X10$	1.968	$2.0X10$	1.301
180	$4.2X10^2$	2.623	$1.2X10^2$	2.079	$2.6X10$	1.414
210	$5.5X10^2$	2.740	$1.6X10^2$	2.204	$3.8X10$	1.579

(3) Total Spore form bacterial count of pepper:

From table (118) and revealed that the total Spore form bacterial counts changes of pepper induced by gamma irradiation and storage at room temperature during 210 days. Form same table that the initial Spore form, bacterial counts of control pepper sample, at zero time was 1.5 x 10^2 C.F.U/g and slight increased to reached 1.2 x 10^3 C.F.U/g after 210 days of room temperature storage, the same table and figs show that application of gamma irradiation slightly effects on Spore form organisms, there for the Spore form organisms were resistant to irradiation doses, this due probably to their low water content.

As well as during storage at room temperature for 210 days, it was observed that the total Spore form counts of irradiated pepper samples slightly increased, it were 0.6 x 10 and 1.9 x 10 C.F.U/g at zero time, and reached to 3.8 x 10^2 and 7.7 x 10 C.F.U/g after 210 days of room temperature storage for doses 2.5, and 5.0 KGY, respectively. The same observation were also noticed by ***Obied (1987), El-Shamary (1988), and El- Khawas (1995).***

(4) Total Bacillus spp bacterial count of pepper:

Date in table (119) and show that the Bacillus spp organism of control pepper was 2.4 x 10 C.F.U/g at zero time before storage and slightly increase during storage at room temperature reached to 1.8 x 10^2 after 210 days.

Moreover it could be noticed that the treatment with irradiation doses slightly reduced the count of Bacillus spp from 2.4 x 10 C.F.U/g for the control pepper samples to 1.2 x 10 and 6.0 C.F.U/g for irradiated samples at (2.5 and 5.0 KGY) doses, respectively. The

Table (118): Effect of gamma irradiation on sporeform bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$1.5X10^2$	2.176	6.0X10	1.778	1.9 X10	1.278
30	$1.9X10^2$	2.278	7.3X10	1.863	2.4 X10	1.380
60	$2.7X10^2$	2.431	$1.11X10^2$	2.045	2.9 X10	1.462
90	$3.3X10^2$	2.518	$1.3X10^2$	2.113	3.6 X10	1.556
120	$4.6X10^2$	2.662	$1.6X10^2$	2.204	4.6 X10	1.662
150	$5.4X10^2$	2.732	$2.3X10^2$	2.361	5.6 X10	1.748
180	$7.2X10^2$	2.857	$2.9X10^2$	2.462	6.3X10	1.799
210	$1.2X10^3$	3.079	$3.8X10^2$	2.579	7.7X10	1.886

Table (119): Effect of gamma irradiation on Bacillus spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.4X10	1.380	1.24X10	1.093	6.0	0.778
30	3.5X10	1.544	1.4X10	1.146	7.7	0.886
60	3.9X10	1.591	2.2X10	1.342	9.1	0.959
90	5.6X10	1.748	2.6X10	1.414	1.1X10	1.041
120	7.8X10	1.892	3.3X10	1.518	1.3X10	1.113
150	$1.3X10^2$	2.113	4.4X10	1.643	1.7X10	1.230
180	$1.5X10^2$	2.176	5.2X10	1.716	1.9X10	1.278
210	$1.8X10^2$	2.255	7.1X10	1.851	2.4X10	1.380

previous results indicated that <u>Bacillus spp</u> organisms were the one of resistant type to irradiation, due probable to their low count before irradiation. And to their low water.

In other hand the total <u>Bacillus spp</u> count of irradiated pepper slightly increased during storage at room temperature reaching 7.1 x 10 and 2.4 x 10 C.F.U/g after 210 days for the ascending doses respectively. The same results are in agreement with ***Baxter and Holzapfel (1982); Shamshed et al (1985); Labai et al (1985); Obied (1987); Hammad et al (1987); Munasiri et al (1987); Toru et al (1993) and El-Khawas (1995).***

(5) Total pathogenic bacterial count of pepper:

Spices or dry pepper are of interest to pathogenic organisms for four principal reasons. They may (1) become moldy if held at improper humidity and temperature (2) contain large numbers of microorganisms that occasionally may cause spoilage of more rarely disease, when introduced into food (3) exhibit anti microbial activity and occasionally aid in preservation, and (4) stimulate microbial metabolism.

Application of gamma irradiation aid to destruction of microbiologists (especially pathogenic organisms), and the effect of gamma irradiation as antibacterial agent. These results obtained by several investigators ***Singh et al (1988); Makoto et al (1989), El-Khawas (1995); U.S.D.A (1997); and Owczarczk et al (1999).***

The types and species of pathogenic bacteria are illustrated in Tables (120-127) from these tables in coulded that <u>Yeast</u> and <u>Moulds</u> (Table 120), <u>Clostridium spp</u> (Table 121), <u>Enteriobacteriaceae</u> (Table 122), <u>Entrocococci spp</u> (Table 123), <u>Coliform group</u> (Table 124), Salmonella spp (Table 125), Staphylococcus spp (Table 126) and Streptococcus spp (table 127).

Data in these table revealed that the previous pathogenic bacteria of pepper samples under investigation during storage at room temperature for 210 days induced by gamma irradiation at (2.5 and 5.0 KGY). These pathogenic bacteria may present in Dry pepper tissueses as natural flora on the dry foods and also may reach to the dry food during, treatment drying, packing, handling, transporting and markting as reported by ***Baxter and Holzapfel (1982).***

Moreover these types and species of pathogenic bacteria recovered before irradiation, but in small numbers ranged from 2.0 C.F.U/g (Table 125) to 2.9 x 10 C.F.U/g (Table 120). The effects of safety gamma irradiation doses used in this study on the pathogenic bacterial count shown in tables (120-127) it could be noticed that using 2.5 KGY gamma radiation was sufficient for complete elimination of these organisms in pepper samples, as well as that the dose 5.0 KGY are quite enough to eliminate these organisms.

This coincides with the finding of ***Hammad et al (1987); Munasiri et al (1987); Singh et al (1988), Morkoto, et al (1989); Toru et al (1993); El-Khawas (1995); and Crawford (1999).***

In addition the results in same tables (120-127) indicate that the initial count of control pepper (unirradiated pepper samples) slightly increased during storage at room temperature for 210 days. Similar results were confirmed by ***El-Khawas (1995), U.S.D (1997), and Owczarczyk et al (1999).***

Table (120): Effect of gamma irradiation on yeast and mould count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.9X10	1.462	Nil	Nil	Nil	Nil
30	3.7X10	1.568	Nil	Nil	Nil	Nil
60	4.8X10	1.681	Nil	Nil	Nil	Nil
90	5.3X10	1.724	Nil	Nil	Nil	Nil
120	7.1X10	1.851	Nil	Nil	Nil	Nil
150	8.0X10	1.903	Nil	Nil	Nil	Nil
180	$1.2X10^2$	2.079	Nil	Nil	Nil	Nil
210	$1.4X10^2$	2.146	Nil	Nil	Nil	Nil

Nil=No viable count

Table (121): Effect of gamma irradiation on Clostridium spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.5	0.544	Nil	Nil	Nil	Nil
30	3.9	0.591	Nil	Nil	Nil	Nil
60	4.1	0.612	Nil	Nil	Nil	Nil
90	5.0	0.698	Nil	Nil	Nil	Nil
120	5.8	0.763	Nil	Nil	Nil	Nil
150	6.2	0.792	Nil	Nil	Nil	Nil
180	7.0	0.845	Nil	Nil	Nil	Nil
210	8.4	0.924	Nil	Nil	Nil	Nil

Nil=No viable count

Table (122): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.8X10	1.447	Nil	Nil	Nil	Nil
30	4.6X10	1.662	Nil	Nil	Nil	Nil
60	7.5X10	1.875	Nil	Nil	Nil	Nil
90	$1.23X10^2$	2.089	Nil	Nil	Nil	Nil
120	$2.0X10^2$	2.301	Nil	Nil	Nil	Nil
150	$3.4X10^2$	2.531	Nil	Nil	Nil	Nil
180	$5.5X10^2$	2.740	Nil	Nil	Nil	Nil
210	$9.9X10^2$	2.995	Nil	Nil	Nil	Nil

Nil=No viable count

Table (123): Effect of gamma irradiation on Enterocococci spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.5X10	1.176	Nil	Nil	Nil	Nil
30	2.2X10	1.342	Nil	Nil	Nil	Nil
60	3.3X10	1.518	Nil	Nil	Nil	Nil
90	4.6X10	1.662	Nil	Nil	Nil	Nil
120	7.4X10	1.869	Nil	Nil	Nil	Nil
150	$1.2X10^2$	2.079	Nil	Nil	Nil	Nil
180	$1.8X10^2$	2.255	Nil	Nil	Nil	Nil
210	$2.5X10^2$	2.397	Nil	Nil	Nil	Nil

Nil=No viable count

Table (124): Effect of gamma irradiation on coliform group bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	8.0	0.903	Nil	Nil	Nil	Nil
30	1.3 X10	1.113	Nil	Nil	Nil	Nil
60	2.4 X10	1.380	Nil	Nil	Nil	Nil
90	3.8X10	1.579	Nil	Nil	Nil	Nil
120	5.6X10	1.748	Nil	Nil	Nil	Nil
150	8.4X10	1.924	Nil	Nil	Nil	Nil
180	$1.5X10^2$	2.176	Nil	Nil	Nil	Nil
210	$2.8X10^2$	2.447	Nil	Nil	Nil	Nil

Nil=No viable count

Table (125): Effect of gamma irradiation on Salmonella spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	2.0	0.301	Nil	Nil	Nil	Nil
30	2.0	0.301	Nil	Nil	Nil	Nil
60	3.0	0.477	Nil	Nil	Nil	Nil
90	4.2	0.623	Nil	Nil	Nil	Nil
120	5.9	0.770	Nil	Nil	Nil	Nil
150	8.9	0.949	Nil	Nil	Nil	Nil
180	1.2X10	1.079	Nil	Nil	Nil	Nil
210	1.2X10	1.079	Nil	Nil	Nil	Nil

Nil=No viable count

Table (126): Effect of gamma irradiation on Staphylococcus spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	7.2	0.857	Nil	Nil	Nil	Nil
30	9.5	0.799	Nil	Nil	Nil	Nil
60	1.56X10	1.193	Nil	Nil	Nil	Nil
90	2.4X10	1.380	Nil	Nil	Nil	Nil
120	3.8X10	1.579	Nil	Nil	Nil	Nil
150	5.3X10	1.724	Nil	Nil	Nil	Nil
180	8.8X10	1.944	Nil	Nil	Nil	Nil
210	$1.4X10^2$	2.146	Nil	Nil	Nil	Nil

Nil=No viable count

Table (127): Effect of gamma irradiation on Streptococcus spp bacterial count of Red hot pepper during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.6	0.662	Nil	Nil	Nil	Nil
30	7.2	0.857	Nil	Nil	Nil	Nil
60	1.22X10	1.086	Nil	Nil	Nil	Nil
90	1.5X10	1.176	Nil	Nil	Nil	Nil
120	2.3X10	1.361	Nil	Nil	Nil	Nil
150	3.5X10	1.544	Nil	Nil	Nil	Nil
180	5.0X10	1.698	Nil	Nil	Nil	Nil
210	7.6X10	1.880	Nil	Nil	Nil	Nil

Nil=No viable count

4-10- Effect of gamma irradiation and storage at room temperature on the chemical composition of Fenugreek flour.

(1) Mositure content of Fenugreek flour:

From data in table (128) it could be noticed that the moisture contents was 11.631% for unirradaited fenugreek flour at zero time this results agree with ***Iso 1982, Sharawy (1985) and Leung and Foster (1996).***

The same results indicated that gamma irradiation and storage at room temperature for 210 days had no real effects on the moisture content of fenugreek flour samples, there for the moisture content of irradiated Fenugreek flour reached to 10.984 and 10.081% for exposed to 2.5 and 5.0 KGY respectively. As well as after storage at room temperature for 210 days, the moisture content of unirradiated and irradiated fenugreek flour reached to 11.7, 11.070 and 10.17% which exposed to 0.0, 2.5 and 5.0 KGY respectively. Those results agree with ***Sharawy (1985), Nobutada (1991), Piggott and Othman (1993) and Newal et al (1996).***

(2) Protein content of Fenugreek flour:

Data presented in table (129) show the effect of gamma irradiation on protein content of Fenugreek flour during storage at room temperature for 210 days. It is obvious from those results that the applied doses of gamma irradiation at 2.5 and 5.0 KGY had no remarkable effects on the protein content of Fenugreek flour samples. In other hand the protein contents of Fenugreek flour samples were 24.21, 24.0 and 23.85% for exposed to 0.0, 2.5 and 5.0 KGY gamma irradiation doses respectively. As well as the protein content of

Table (128): Effect of gamma irradiation on moisture content of Fenugreek flour, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	moisture %	Variation %	moisture %	Variation %	moisture %	Variation %
0	11.631	0.000	10.984	0.000	10.081	0.000
30	11.658	0.232	10.980	-0.036	10.100	0.188
60	11.685	0.464	11.001	0.154	10.080	-9.919
90	11.630	-8.597	11.019	0.318	10.081	0.000
120	11.631	0.000	11.037	0.482	10.120	0.386
150	11.739	0.928	10.983	-9.104	10.139	0.575
180	11.766	1.160	11.054	0.637	10.150	0.684
210	11.793	1.392	11.070	0.782	10.178	0.962

Table (129): Effect of gamma irradiation on the total protein content of Fenugreek flour, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	protein %	Decrease %	protein %	Decrease %	protein %	Decrease %
0	24.211	0.000	24.000	0.000	23.854	0.000
30	24.003	-0.859	23. 778	-0.925	23.824	-0.125
60	23.795	-1.718	23.557	-1.845	22.993	-3.609
90	23.587	-2.577	23.336	-2.766	22.963	-3.604
120	23.379	-3.436	23.114	-3.691	22.933	-3.860
150	23.171	-4.295	22.893	-4.612	22.803	-4.405
180	22.963	-5.154	22.672	-5.533	22.873	-4.112
210	22.756	-6.009	22.451	-6.454	22.443	-5.915

samples under investigation slightly decreased during storage at room temperature for 210 days reached to 22.75, 22.45 and 22.44% for the ascending treated Fenugreek flour samples respectively. These results might be due to decomposition of Fenugreek flour by microorganisms during storage at room temperature. These results are in agreement with. ***Piggott and Othman (1993).***

(3) Fat content of Fenugreek flour:

Table (130) could be noticed that the fat changes of Fenugreek flour induced by gamma irradiation and storage at room temperature for 210 days are showen in table (130) that the fat contents before storage at zero time were 7.34, 7.26 and 6.99% for unirradiated and irradiated fenugreek flour sample at (2.5 and 5.0 KGy) respectively. This agree with ***Leung (1980), El-Sharawy (1985) and Obied (1987).*** There for it is obvious from these results that the applied doses of gamma irradiation and storage at room temperature had no remarkable effects on the fat content of Fenugreek flour.

Form same table (130) indicated also the fat content of unirradiated and irradiated Fenugreek flour samples slightly decreased during storage at room temperature reached to 6.618, 6.838 and 6.848% after 210 days for exposed to 0.0, 2.5 and 5.0 KGY gamma irradiation dose respectively. These decrease may be due to active of microorganism which secrete lipase enzymes that cause oxidation of fat, which was be also responsible for decrease of the total lipids content during storage at room temperature as reported by. ***El-Hady (1982) Sharway (1985), Nobutada (1991) Piggott and Othman (1993), Leung and Foster (1996) and Newal et al (1998).***

(4) Ash content of Fenugreek flour:

Effect of gamma irradiation on Ash content of Fenugreek flour sample during storage at room temperature for 210 days, as seen in table (131), it is obvious from the data obtained in same table that ash content of Fenugreek flour samples there were no significant changes due to either gamma irradiation (2.5 and 5.0 KGY) or storage at room temperature for 210 days.

However the data in table (131) indicated that the Ash content of unirradiated and irradiated Fenugreek flour samples before and after storage at room temperature was the same about (4.6, 4.5%). Simmilar with ***Sharawy (1985), Obied (1987), El-Kawas (1995) and Leung and Foster (1996).***

4-11- Effect of gamma irradiation and microbial Aspects of Fenugreek flour during storage at room temperature

The Fenugreek flour differ in their composition and microbial flora depending on the condition of fenugreek seeds at harvest and the postharvest processing, storage, marketing, etc. ***El-Sharawy (1985), and Obied (1987).***

Fenugreek flour may be contaminated with pathogenic bacteria during preparation and processing operations of fenugreek seeds. The quality of fenugreek flour is largely dependent on their microbial contamination, therefore any technological treatment can be effectively used, to eliminate or destroy the pathogenic microorganisms. Irradiation was found to be the only processing technique which is likely to over come food poisoning from fenugreek flour.

Table (130): Effect of gamma irradiation on the fat content of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	fat %	Decrease %	fat %	Decrease %	fat %	Decrease %
0	7.340	0.000	7.262	0.000	6.998	0.000
30	7.203	-1.866	7. 108	-2.120	6.944	-0.771
60	7.066	-3.732	6.954	-4.241	6.926	-1.028
90	6.929	-5.599	6.800	-6.361	6.847	-2.157
120	6.792	-7.465	6.846	-5.728	6.849	-2.129
150	6.655	-9.332	6.792	-6.472	6.870	-1.829
180	6.618	-9.836	6.838	-5.838	6.852	-2.086
210	6.618	-9.836	6.838	-5.838	6.848	-2.142

Table (131): Effect of gamma irradiation on the ash content of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	ash %	variation %	ash %	variation %	ash %	variation %
0	4.601	0.000	4.590	0.000	4.561	0.000
30	4.615	0.304	4.592	0.043	4.559	-0.043
60	4.601	0.000	4.595	0.108	4.568	0.153
90	4.610	0.195	4.589	-0.021	4.557	-0.087
120	4.600	-0.021	4.601	0.239	4.561	0.000
150	4.601	0.000	4.600	0.217	4.561	0.000
180	4.599	-0.043	4.590	0.000	4.554	-0.153
210	4.630	0.630	4.591	0.000	4.553	-0.173

(1) Total Aerobic bacterial count of Fenugreek flour:

From table (132) shows that the effect of different treatment irradiation dose on the total Aerobic bacterial count of Fenugreek flour during storage at room temperature.

From this table and figures it could be seen that the unirradiated Fenugreek flour sample at zero time was $1.0x10^3$ C.F.U/g. this value was in agreement of the Egyptian legal standards and within the range given for Fenugreek flour similar results ***El-Sharawy (1985), Obied (1987), and El-Khawas (1995),***

After irradiation of the Fenugreek flour samples with 2.5 and 5.0 KGY, reduced the bacterial load to 1.0×10^2 and 8.1 C.F.U/g respectively. In other hand the reduction percentages were 90% and 99.2% for the above mentioned doses comparing with their control samples (unirradiated samples). Respectively, the reduction of total bacterial counts attributed to the cold sterilization effect of irradiation on the microorganisms. Agreed with ***El-Khawas (1995)***, During subsequent room temperature storage slight increase in total bacterial count, it reached to 7.0×10^4, 3.2×10^2 and 2.6×10 C.F.U/g after 210 days of unirradiated and irradiated Fenugreek flour samples with 0.0, 2.5 and 5.0 KGY respectively.

The total plate count of viable Aerobic bacterial were taken as index of microbial changes in food tissues during storage at room temperature. From the aforementioned data it is clear that the 5.0 KGY treatment is the best for keeping the total aerobic bacterial counts of Fenugreek four at lower level during storage at room temperature and hence give the longest shelf-life. These results are in agreement with those obtained by ***El-Sharawy (1985), Obied (1987), El-Shamerry (1988), and El-Khawas (1995).***

(2) Total Anaerobic bacterial count of Fenugreek four:

The results in table (133) illustrate the effect of gamma irradiation (2.5 and 5.0 KGY) on Anaerobic bacterial counts of Fenugreek flour before and after storage at room temperature for 210 days. It is evident from these results that the unirradiated Fenugreek flour sample at zero time had 6.4 x 10 C.F.U/g and reduced to 1.0 x 10 and 4.0 C.F.U/g, when exposed to 2.5 and 5.0 KGY respectively. The reduction in the anaerobic bacterial counts is mainly due to effects of gamma irradiation on this microorganism as reported by ***El-Khawas (1995).*** From the same table, it could be noticed that total Anaerobic bacterial counts of unirradiated and irradiated Fenugreek flour samples slight increasing during storage at room temperature, after 210 days the counts reached to 2.8 x 10^2,8.0 x 10 and 1.5 x 10 C.F.U/g, for treatment to 0.0, 2.5 and 5.0 KGY respectively. This results similar with ***El-Khawas (1995).***

(3) Total Spore form bacterial count of Fenugreek flour:

The spore form bacterial counts of Fenugreek flour induced by gamma irradiation and stored at room temperature seen in table (134) the results indicated that <u>Spore form</u> organism were the most resistant type to irradiation, that even at dose level of 5.0 KGY. However the <u>Spore form</u> counts before storage at zero time was 9.0 x 10 C.F.U/g for unirradiated Fenugreek flour sample and was 4.2 x 10 and 1.4 x 10 C.F.U/g for irradiated samples at 2.5 and 5.0 KGY respectively.

In addition during storage their total counts numbers increase at relatively slow rate, with the time of storage increasing under same

Table (132): Effect of gamma irradiation on total aerobic bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	$1.0X10^3$	3.000	$1.0X10^2$	2.000	8.1	0.908
30	$1.7X10^3$	3.230	$1.2X10^2$	2.079	9.6	0.982
60	$3.1X10^3$	3.491	$1.5X10^2$	2.176	1.1X10	1.041
90	$6.0X10^3$	3.773	$1.7X10^2$	2.230	1.4X10	1.146
120	$9.3X10^3$	3.968	$1.9X10^2$	2.278	1.5X10	1.176
150	$1.8X10^4$	4.255	$2.2X10^2$	2.342	1.8X10	1.255
180	$3.0X10^4$	4.477	$2.8X10^2$	2.447	2.0X10	1.301
210	$7.0X10^4$	4.845	$3.2X10^2$	2.505	2.6X10	1.414

Table (133): Effect of gamma irradiation on total anaerobic bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	6.4X10	1.806	1.0X10	1.000	4.0	0.602
30	7.8X10	1.892	1.6X10	1.204	5.0	0.698
60	9.5X10	1.977	2.2X10	1.342	6.0	0.778
90	$1.1X10^2$	2.041	3.2X10	1.505	7.0	0.845
120	$1.4X10^2$	2.146	3.9X10	1.591	7.8	0.892
150	$1.7X10^2$	2.230	4.9X10	1.690	8.0	0.903
180	$2.1X10^2$	2.322	6.0X10	1.778	1.1X10	1.041
210	$2.8X10^2$	2.447	8.0X10	1.954	1.5X10	1.176

Table (134): Effect of gamma irradiation on sporeform bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	9.0X10	1.954	4.2X10	1.623	1.4X10	1.146
30	$1.0X10^2$	2.000	5.2X10	1.716	1.6X10	1.204
60	$1.5X10^2$	2.176	6.4X10	1.806	1.9X10	1.278
90	$2.2X10^2$	2.342	7.8X10	1.892	2.2X10	1.342
120	$1.6X10^2$	2.204	9.9X10	1.995	2.5X10	1.414
150	$2.6X10^2$	2.414	$1.1X10^2$	2.041	2.9X10	1.462
180	$3.2X10^2$	2.505	$1.5X10^2$	2.176	3.7X10	1.560
210	$5.0X10^2$	2.698	$1.8X10^2$	2.255	3.9X10	1.591

condition of storage (at room temperature 210 days) the same results are in agreement with ***El-Shamarry (1988), and El-Mongy (1990).***

(4) Total Bacillus spp bacterial counts of Fenugreek flour:

Table (135) it could be noticed the total Bacillus spp counts (C.F.U/g) of irradiated and control Fenugreek flour storage at room temperature, it is obvious from the same table and figs that the initial Bacillus spp counts of control Fenugreek flour samples at zero time and before storage was 1.3x10 C.F.U/g and slightly increase during storage at room temperature reached to 1.2 x 10^2 C.F.U/g after 210 days. Application of gamma irradiation led to slight reduction in Bacillus spp microorganism. This result may be due to Bacillus ssp organism were resistant type to irradiation like spore form bacteria. However form same table it indiactes also During storage at room temperature the irradiated samples at 2.5 and 5.0 KGY slightly increase with the time of storage increasing they increased from 7.0 and 3.0 C.F.U/g at zero time before storage to reached 9.3 x 10 and 1.6 x 10 C.F.U/g after 210 days of storage respectively.

(5) Total pathogenic organisms count of Fenugreek flour:

Irradiation is safe technology for dry food like (Fenugreek flour) and has been recognized as such by fao/ who codex Ali mentarius. Commission. The pathogenic bacteria mainly Yeast and Mould, Clostridium spp, Enteriobacteriaceae, Entrocococci spp, Coliform group, Salmonella spp, Staphglococcus spp and Streptococcus spp are shwen in tables (136 – 143) the results in same tables illustrate the effect of gamma irradiation on the previous types and species of pathogenic bacteria of Fenugreek flour before and after irradiation during storage at room temperature, furthermore these

Table (135): Effect of gamma irradiation on Bacillus spp bacterial count of Fenugreek flour, during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.3X10	1.113	7.0	0.845	3.0	0.477
30	1.7X10	1.230	8.0	0.903	3.8	0.579
60	2.5X10	1.397	1.3X10	1.113	4.2	0.623
90	3.1X10	1.491	1.8X10	1.255	6.1	0.785
120	4.2X10	1.623	2.4X10	1.380	7.0	0.845
150	5.5X10	1.740	3.3X10	1.518	9.2	0.963
180	7.1X10	1.851	4.5X10	1.653	1.2X10	1.079
210	$1.2X10^2$	2.079	9.3X10	1.968	1.6X10	1.204

member of pathogenic bacteria, recovered before irradiation but in relatively small number (tables 136 – 143) ranged from 1.8 C.F.U/g to (table 138) 3.4 x 10 C.F.U/g (table 137). In addition irradiation treatments at the different. Applied doses (2.5 and 5.0 KGY) eliminated the few cells of these member organisms that were present in Fenugreek flour samples before irradiation. However the lowest dose was found to be enough for destruction of these pathogenic microorganisms. These findings were in agreement with those obtained by manyinvestgators ***Thayer (1995), U.S.D.A (1997), Crawford (1999) Owczarczk et al (1999), and Afifi and Nashaby (2001),*** who reported that gamma irradiation doses (2 to 10 KGY) had a great effect to kill the pathogenic bacteria i.e Salmonella, listeria, Staphylococcus, Streptococcus, E. coli, Closteridium and others that cause food borne illness. On the other hand the total count of these microorganisms on unirradiated Fenugreek flour samples slightly increased during storage at room temperature (for 210 days). Generally, it could be concluded that the application of gamma irradiation at dose (2.5 KGy) was enough and sufficient for complete destruction of food borne pathogens under taken and spoilage micro flora these result agree with ***B.M.A (1989), E.Demaro (1999) and Afifi and Nashaby (2001).***

Table (136): Effect of gamma irradiation on yeast and mould count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.4X10	1.531	Nil	Nil	Nil	Nil
30	4.0X10	1.602	Nil	Nil	Nil	Nil
60	5.8X10	1.763	Nil	Nil	Nil	Nil
90	6.0X10	1.778	Nil	Nil	Nil	Nil
120	7.0X10	1.845	Nil	Nil	Nil	Nil
150	7.8X10	1.892	Nil	Nil	Nil	Nil
180	8.6X10	1.934	Nil	Nil	Nil	Nil
210	$1.9X10^2$	2.278	Nil	Nil	Nil	Nil

Table (137): Effect of gamma irradiation on Clostridium spp bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.6	0.556	1.8	0.255	Nil	Nil
30	4.4	0.643	2.1	0.322	Nil	Nil
60	6.3	0.799	3.0	0.477	Nil	Nil
90	7.5	0.875	3.0	0.477	Nil	Nil
120	9.1	0.959	3.1	0.491	Nil	Nil
150	1.1X10	1.041	3.8	0.579	Nil	Nil
180	1.4X10	1.146	3.9	0.591	Nil	Nil
210	1.8X10	1.255	5.0	0.698	Nil	Nil

Nil=No viable count

Table (138): Effect of gamma irradiation on Enteriobacteriaceae bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	1.1X10	1.041	Nil	Nil	Nil	Nil
30	1.7X10	1.230	Nil	Nil	Nil	Nil
60	2.8X10	1.447	Nil	Nil	Nil	Nil
90	4.8X10	1.662	Nil	Nil	Nil	Nil
120	6.7X10	1.826	Nil	Nil	Nil	Nil
150	$1.2X10^2$	2.079	Nil	Nil	Nil	Nil
180	$1.74X10^2$	2.240	Nil	Nil	Nil	Nil
210	$3.0X10^2$	2.477	Nil	Nil	Nil	Nil

Nil=No viable count

Table (139): Effect of gamma irradiation on Enterocococci spp bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	9.0	0.954	Nil	Nil	Nil	Nil
30	1.3X10	1.113	Nil	Nil	Nil	Nil
60	1.9X10	1.278	Nil	Nil	Nil	Nil
90	2.6X10	1.414	Nil	Nil	Nil	Nil
120	4.4X10	1.643	Nil	Nil	Nil	Nil
150	7.1X10	1.851	Nil	Nil	Nil	Nil
180	9.2X10	1.963	Nil	Nil	Nil	Nil
210	$1.5X10^2$	2.176	Nil	Nil	Nil	Nil

Nil=No viable count

Table (140): Effect of gamma irradiation on coliform group bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	3.0	0.477	Nil	Nil	Nil	Nil
30	4.5	0.653	Nil	Nil	Nil	Nil
60	7.7	0.886	Nil	Nil	Nil	Nil
90	1.5X10	1.176	Nil	Nil	Nil	Nil
120	2.2X10	1.342	Nil	Nil	Nil	Nil
150	3.3X10	1.518	Nil	Nil	Nil	Nil
180	$5.2X10^2$	1.716	Nil	Nil	Nil	Nil
210	$8.8X10^2$	1.944	Nil	Nil	Nil	Nil

Nil=No viable count

Table (141): Effect of gamma irradiation on Salmonella spp bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	Nil	Nil	Nil	Nil	Nil	Nil
30	3.0	0.477	Nil	Nil	Nil	Nil
60	3.0	0.477	Nil	Nil	Nil	Nil
90	3.8	0.579	Nil	Nil	Nil	Nil
120	4.5	0.653	Nil	Nil	Nil	Nil
150	6.0	0.778	Nil	Nil	Nil	Nil
180	8.1	0.908	Nil	Nil	Nil	Nil
210	1.1X10	1.041	Nil	Nil	Nil	Nil

Nil=No viable count

Table (142): Effect of gamma irradiation on Staphylococcus spp bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	6.0	0.778	Nil	Nil	Nil	Nil
30	7.6	0.880	Nil	Nil	Nil	Nil
60	1.0X10	1.000	Nil	Nil	Nil	Nil
90	1.8X10	1.255	Nil	Nil	Nil	Nil
120	2.6X10	1.414	Nil	Nil	Nil	Nil
150	4.4X10	1.643	Nil	Nil	Nil	Nil
180	7.1X10	1.851	Nil	Nil	Nil	Nil
210	$1.2X10^2$	2.079	Nil	Nil	Nil	Nil

Nil=No viable count

Table (143): Effect of gamma irradiation on Streptococcus spp bacterial count of Fenugreek flour during storage at roomtemperature.

Dose (KGY)	0.0		2.5		5.0	
Storage Period (In days)	Count / g	Log	Count / g	Log	Count / g	Log
0	4.0	0.602	Nil	Nil	Nil	Nil
30	6.0	0.778	Nil	Nil	Nil	Nil
60	9.1	0.959	Nil	Nil	Nil	Nil
90	1.3X10	1.113	Nil	Nil	Nil	Nil
120	2.0X10	1.301	Nil	Nil	Nil	Nil
150	2.9X10	1.462	Nil	Nil	Nil	Nil
180	4.4X10	1.643	Nil	Nil	Nil	Nil
210	7.6X10	1.880	Nil	Nil	Nil	Nil

Nil=No viable count