EFFECT OF GAMMA RADIATION ON THE MICROBIAL PROPERTIES OF BEEFBURGER

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INTRODUCTION :

Extensive research has shown, that treatment with ionizing radiation at doses up to approximately 5 KGy (0.5 Mrad) suffices to adequately reduce the number of viable nonsporing pathogenic microorganisms in foods and therefore,is an attractive decontamination method (FAO/IAEA/WHO,1977).

Effect of -Radiation on microorganisms has been studied by many investigators,Farkas,1981, El-Bazza (1983), Hammad(1985) Dickson and Maxcy(1985)and Youssef (1987).

This work aimed to study the effect of gamma radiation with 5 KGy, on eliminating some contaminating microorganisms from chilled beefburgers as well as its effect on extending their shelf life on storage at 2°C ± 1.

MATERIALS AND METHODS :

Fresh beefburger samples were obtained immediately after processing; to study the effect of gamma rays on pathogens and extension of their shelf life . Every two portions were kept in palyethylene bags. Thereafter the bags were irradiated before storing at 2 ± 1°C and were analysed at different intervals during storage.

The irradiation process was carried out at the National Center for Radiation Research and Technology, Nasr City Cairo , using the Egypt's industrial Mega - Gamma irradiator. The source was cobalt 60. The dose rate at the time of experiments was KGY / 28 min. The doses applied were 0.0 and 5 KGy.

The unirradiated and irradiated samples were stored at 2°C ± 1. The samples were analysed microbiologically during storage for total viable counts of bacteria, sporeformers,molds,yeasts, *Strepto. faecolis*,*Staph. aureus* and *intropathogenic E. coli*. The detection of *B. cereus Cl. perfringens* and *Salmonella spp.* was also carried out .

Ten gams of the sample were mixed well with 90 ml of saline solution (8.59 Nacl+ 1 g peptone/ L) serial dilutions method was used for the microbiological tests .

Total bacterial counts per 1 gm sample was determined by using the plate count agar medium and incubated at 30°C for 48 hrs as recommended by the American Public Health Association (APHA),1960.

Aerobic sporeformers counts were determined according to the method described by Chalmers(1955).

Mold and yeasts were counted on oxytetracycline glucose yeast extract agar medium.(Oxide Manual , 1982).

Staphylococcus aureus was enumerated on laboratory prepared Baird. Parker medium as recorded by IAEA (1970). DN-ase test was used as a confirmation test(Oxoid Manual, 1982).

Streptococcus faecolis was counted on Kanamycin aesculin azide agar medium as recommended by Mossel et al.,1973.

Enteropathogenic *E. coli* was counted using the MPN method as reported by IAEA,1970.

Detection of salmonella was carried out using the most probable number technique according to Iso (1987).

Detection of *Celostridium perfringens* was done as mentioned by Stephen et al.(1975). Positive colonies are characterized by the ability to liquify gelatin after

24 - 44 hrs(Houschild and Hiloheimer (1974).

Detection of *Bacillus cereus* was carried out as described by Mossel et al.(1967).

RESULTS AND DISCUSSION :

Data in Table (1) showed the total bacterial counts in unirradiated and irradiated beefburger during storage at 2°C ± 1.It is clear from the results that the total bacterial counts were sharply reduced by irradiation treatments. The initial bacterial counts in unirradiated sample was 1.1×16^6, was reduced to 2.5×10^2 cells/g as a result of irradiation with 5.0 KGy. These results are in agreement with those obtained for sausage (Hassan , 1967 and Emam,1987) .

During cold storage at 2°C ± 1 progressive increase in the total bacterial counts of unirradiated and irradiated beefburger with almost the same rate specially after the first period of storage. However,the total bacterial counts remained lower in irradiated samples allover the storage period (8 weeks). At the end of 8th week of storage the bacterial counts reached 9.5×10^8 cells/g and $2.0\ 10^6$ cells / g in the control and irradiated samples. At this time the control and irradiated samples were rejected . The control samples were rejected due to high levels of bacteria while the irradiated samples were rejected due to the appearance of fungi spots on the surface of beefburger.Daelman and Hoof(1975) gave a proliferation of microorganisms was highly influenced by storage temperature. While a storage temperature of 10°C appeared ineffective to assure an acceptable quality; a temperature of 2°C gave a sausage of excellent microbial quality even after storage for 21 days .

The results in Table (2)also indicated that sporeforming bacteria were more resistant to gamma radiation than total bacteria since about 4 log cycles were reduced in total counts by 5 KGy, while only one log cycle was occurred by the same dose in sporeformers. Similar results were reported by Vankooji (1981).The main reason that spores are radiation resistant is probably due to their low water content,which reduces the efficiency of ionizing event (Tallentire,1970).

The mean counts increased from 9.0×10^2 to 1.7×10^4 ceels/g and from 4.0×10 to 1.0×10^3 cells/g after 8 weeks in unirradiated and irradiated beefburger samples respectively.

The results in Table(2)clearly indicated that gamma irradiation with dose of 5.0 KGy inhibited either yeasts or molds in beefburger samples . However , the yeasts started to multiply after one week of storage whereas few coloneis of molds appeared after 2 weeks in the irradiated samples. During storage the yeast counts of unirradiated and irradiated samples increased by almost the same rate after the first period of storage reaching 1.2×10^5, 2.7×10^5 CFU/g at the end of the 8th week for the irradiated and unirradiated samples respectively. On the other hand the counts of mold increased sharply in irradiated samples after the 2nd week of storage reaching 7.4×10^5 CFU/g at the end of the 8th week , whereas,their counts in the control were only 1.9×10^4 CFU/g at the same week. As previously mentioned the irradiated samples were rejected due to the appearance of fungus spots on the surface of beefburger.

The same findings were also obtained by Corelett et al.(1965) and Youssef (1981) for irradiated fish and Bolti fish fillet respectively.

Data in Table (3) showed that the initial counts of *Strept. faecalis* ,enteropathogenic *E. coli* and *Staph. aureus* were 1.2×20^5, 1.6×10^4 and 1.0×10^4 cells/g

respectively . In unirradiated beefburger samples.Application of gamma radiation at 5.0 KGy dose level completely suppressed these pathogens in beefburger samples. On the other hand,the counts of these organisms in the unirradiated beefburger reduced as storage period advanced at 2°C ± 1,reaching 6.5×10^2 cells/g in case of *Strept. faecalis*. Meanwhile,on growth of either enteropathogenic *E. coli* or *Staph. aureus* was observed after 6 weeks storage .

The results in Table (4) revealed that irradiation with 5.0 KGy dose level was not sufficient to eliminate *B. cereus* from beefburger product.Ingram and Roberts (1980) reportedthat some spores of *B. cereus* are amont the most resistant *B. spp.* Meanwhile , neither *Cl.perfringens* nor *Salmonella spp.* were detected in beefburger samples.

Table (1) : Effect of gamma radiation on total bacterial counts and sporeformers count of beefburger during storage at 2°C ± 1 , (cells/g) .

Storage period (weeks)	Total bacterial counts		Sporeformers count	
	0.0 KGy	5.0 KGy	0.0 KGy	5.0 KGy
0	1.1×10^6	2.5×10^2	9.0×10^2	4.0×10
1	6.5×10^6	2.7×10^2	1.4×10^3	8.0×10
2	8.5×10^6	3.3×10^3	2.7×10^3	1.1×10^2
4	4.3×10^7	1.1×10^4	4.1×10^3	2.3×10^2
6	1.2×10^8	1.1×10^5	6.0×10^3	5.5×10^2
8	9.5×10^8	2.0×10^6	1.7×10^4	1.0×10^3

Table (2) : Effect of gamma radiation on yeast and mold counts of beefburger during storage at 2°C ± 1, (CFU/g) .

Storage period (weeks)	Yeast		Mold	
	0.0 KGy	5.0 KGy	0.0 KGy	5.0 KGy
0	1.0×10^3	NG	7.0×10	NG
1	2.3×10^3	3.5×10^2	8.5×10	NG
2	2.9×10^3	2.3×10^3	5.5×10^2	1.0×10^2
4	4.6×10^3	5.0×10^4	8.5×10^3	2.6×10^4
6	1.5×10^4	3.0×10^4	3.0×10^3	1.5×10^4
8	1.2×10^5	2.7×10^5	1.9×10^4	7.4×10^5

Table (3) : Effect of gamma radiation on some pathogenic bacteria in beefburger stored at 2°C ± 1. (cells/g).

Storage period (weeks)	*Strept.faecalis*		*Staph.aureus*		*E.coli*	
	0.0 KGy	5.0 KGy	0.0 KGy	5.0 KGy	0.0 KGy	5.0 KGy
0	1.2×10^5	NG	1.0×10^4	NG	1.6×10^4	NG
1	2.1×10^4	NG	5.5×10^3	NG	5.5×10^2	NG
2	7.1×10^3	NG	3.0×10^2	NG	3.1×10^2	NG
4	4.7×10^3	NG	1.0×10^2	NG	3.6×10	NG
6	1.5×10^3	NG	NG	NG	NG	NG
8	6.5×10^2	NG	NG	NG	NG	NG

Table (4) : Incidence of *B.cereus* in unirradiated and irradiated beefburger stored at $2^{o}C \pm 1$.

Storage period (weeks)	0.0 KGy	5.0 KGy
0		
1	+	
2	+	
4	+	
6	+	
8	+	+

CONCLUSION :

The effect of gamma radiation with 5 KGy,on eliminating some contaminating microorganisms from chilled beefburgers as well as its effect on extending their shelf life on storage at $2^{o}C \pm 1$ was studied .

Data revealed that 5 KGy was sufficent to eleminate yeasts, molds,*Strept. faecalis* , *Staph. aureus* and enteropathogenic *E. coli* but did not affect the presence of *B. cereus*. *cl. perfringens* and *Salmonella spp.* were not detected in all samples.

After 8 weeks storage the unirradiated samples were spolied bacteriologically while the irradiated one were rejected due to the appearance of fungi spots on the surface of beefburgers inspite of its lower bacterial counts(2×10^{6} cells/g).

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