

CHANGES IN GAMMA IRRADIATED CANNED BEEF DURING STORAGE I - CHANGES IN BACTERIAL COUNTS

1 FAWZY AHMED SALEM 2 K.M. EL SAHY 3 A. H. RADY 4. A. I. HAMMAD 5 H. M. BADR

1/2 Prof. of Food Sci. & Techn. Dept. of Food Sci., Faculty of Agric, Zagazig Univ.- Egypt 3/4/5 Prof. & Asso. Prof. and Assitant of Food Sci. National Center for Raditioatn Research & Techn. Atomic Energy, Anshas, Egypt

Meat is an ideal medium for microbial growth. Bacteria are the principal exploitation of this medium (Dillon and Board, 1991) in consequence the present investigation was designed to study the effect of different doses (11.25, 22.5 and 45 KGy) on the aerobic, anaerobic, thermophylic bacteria and *Clostridium perfringens* throughout 12 months storage.

Untreated (raw) canned beef and commercially heat sterilized (CS) can (from the same batch which served as control) were obtained from Al-Mohandes National Company. Beefy was made from beef meat with the following ingredients : starch, soy protein, spices, salt, milk protein and sodium nitrite. Samples were immediately transported from the company to the laboratory in Ice-boxes for analyses : CS cans were stored at ambient temperature along with the irradiated ones without any further treatments until analysis.

Irradiation procedures: Preheated and deep frozen cans were exposed to gamma irradiation at 11.25, 22.5 and 45 KGy. All cans under investigation were stored , and samples were withdrawn after 0,1,2,3,5,7,9, and 12 months. The total anaerobic bacterial count was determined according to the method described in Oxid (1982). The total aerobic bacterial count was determined following the method recommended by the APHA (1985). The total thermophilic bacteria was enumerated on plate count agar medium as described by Ito and Thompson (1984). Harmon and Duncan (1984) method was adopted for the detection of *Cl. perfringens*.

Effect of Gamma Irradiation on the Anaerobic Bacteria: The total anaerobic bacterial count of CS canned beef was 10 CFU/g. The 11.25 dose decreased this count by only 46.34% indicating the resistance of some anaerobic bacterial spores to 11.25 dose. Meanwhile, 22.5 dose almost eliminated all anaerobic bacteria. Almost all anaerobic bacteria in the undertaken samples were destroyed by 22.5 and 45 KGy to avoid spoilage. During storage of canned beef, there was an increase in the total anaerobic bacteria of canned beef exposed to 0.0, 11.25 KGy which was much higher in unirradiated cans than irradiated ones. In unirradiated canned beef it reached 1.4×10^6 after only one month and the cans were rejected because of swelling. The total anaerobic bacterial counts of canned beef receiving 11.25 KGy reached 8.5×10^6 after 5 months. These cans were also rejected for swelling. At a dose of 22.5 KGy anaerobic bacterial spores could survive for 9 months and cans showed a slight swelling. The total anaerobic bacterial counts reached only 6.8×10^7 after 9 months in cans irradiated by 22.5 KGy. These results indicate that the canned beef receiving irradiation doses of 11.25 and 22.5 KGy could remain without swelling for 4 and 8 months, respectively. The total anaerobic bacterial count of cans was 85 after 12 months of storage indicating that CS food may contain very small numbers of injured anaerobic bacterial spores which could repair themselves after a long time of storage. In canned beef which was exposed to 45 KGy, the total anaerobic bacterial count was less than 10 up to 7 months and reached 74 after 12 months of storage. This means that some high radiation resistant anaerobic bacteria may survive this irradiation dose and could repair themselves after a long time of storage.

Effects of Gamma Irradiation On the Total Aerobic Bacteria: Results indicate that the total aerobic bacterial count of CS canned beef was 10. Irradiation at 11.25 and 22.5 decreased these counts by 80.4 and 91.4 % respectively. This means that some aerobic bacterial spores were resistant to gamma irradiation and could survive even at 22.5 KGy . Skovgaard (1987) mentioned that, doses up to 30 KGy were required to reduce the spore count of *Bacillus cereus* by a factor of 10^6 in spices. Irradiation dose of 45 appeared to be very effective in eliminating total aerobic bacteria where the total aerobic bacterial counts were 10 and similar to the commercial heat sterilization. During storage of canned beef, the total aerobic bacterial count was increased in unirradiated canned beef and those exposed to 11.25 KGy, but the rate of increase was much higher in unirradiated cans than irradiated ones. The total aerobic bacterial count of unirradiated cans reached 4.7×10^5 after only one month of storage, while this count reached 2.4×10^6 in cans receiving 11.25 KGy after 5 months of storage. The total aerobic bacterial count was increased in unirradiated samples and those receiving 11.25 KGy although beef was canned under vacuum. This could be due to the growth of *Bacillus* spores that could survive mild heat treatment and irradiation. Gibson and Gordon (1974) Collins et al (1989) reported that some species of *Bacillus* are aerobic and facultatively anaerobic. They added that some species of *Bacillus* could

grow under anaerobic conditions. Total aerobic bacterial counts of canned beef receiving 22.5 almost remained constant up to 5 months storage, then counts slightly increased during the last four months of storage reaching 2.1×10^2 after 9 months. In the CS cans, the total aerobic bacterial count after 12 months was 4.0×10^2 indicating that CS cans may contain a small number of heat resistant aerobic bacterial spores.

Influence of gamma irradiation on the total anaerobic, aerobic, thermophilic and Clostridium perfringens bacterial counts of canned beef in comparison to the commercial heat sterilization

St. P. (M)	COMMERCIALLY HEAT STERILIZED CONTROL				IRRADIATION DOSE (KGy)															
					0.0				11.25				22.5				45			
	An	A.	Th	Cl.	An	A.	Th	Cl.	An	A.	Th	Cl.	An	A.	Th	Cl.	An	A.	Th	Cl.
0	<10	<10	<10	-ve	4.1×10^2	5.6×10^2	8.2×10^2	+ve	2.2×10^2	1.1×10^2	<10	+ve	<10	4.8	<10	+ve	<10	<10	<10	-ve
1	<10	<10	<10	-ve	1.4×10^6	4.7×10^5	2.4×10^5	+ve	5.3×10^4	3.7×10^4	5.6×10^3	+ve	<10	40	<10	+ve	<10	<10	<10	-ve
2	<10	<10	<10	-ve	R	R	R	R	2.6×10^5	7.8×10^4	2.1×10^4	+ve	<10	80	<10	+ve	<10	<10	<10	-ve
3	<10	<10	<10	-ve	--	--	--	-	2.2×10^5	8.6×10^4	4.2×10^4	+ve	7.3×10^1	30	<10	+ve	<10	<10	<10	-ve
5	<10	<10	<10	-ve	--	--	--	-	8.5×10^6	2.8×10^6	1.6×10^6	+ve	3.3×10^2	30	<10	+ve	<10	<10	<10	-ve
7	380	65	<10	-ve	--	--	--	-	R	--	R	R	2.1×10^2	200	<10	+ve	<10	<14	<10	-ve
9	210	280	<10	-ve	--	--	--	-	--	--	--	-	6.8×10^2	210	<55	+ve	70	20	<10	-ve
12	850	400	80	-ve	--	--	--	-	--	--	--	-	R	R	R	R	74	71	53	-ve

St. = storage p= period m = month An. = Anaerobic A= Aerobic Th. = Thermophilic Cl = Clostridium R=Rejected
In canned beef exposed to 45 KGy the total aerobic bacterial count was less than 10 up to 5 months. This count reached 71 after 12 months of storage indicating that there was a few number of aerobic bacterial spores could survive even upon exposure to this high radiation dose.

Effects of Gamma Irradiation on the Total Thermophilic bacteria: The total thermophilic bacteria of CS beef was 10. where as that of mild heat treated (control) before irradiation was 8.2×10^2 . In canned beef irradiated at 11.25, 22.5 and 45 KGy it was 10. During storage these counts increased in unirradiated canned beef and those exposed to 11.25 KGy. The total thermophilic bacteria in unirradiated canned beef reached 2.4×10^5 after one month of storage (which was rejected) while the count of the total thermophilic bacteria of canned beef receiving 11.25 KGy reached 1.6×10^6 after 5 months of storage. Canned beef exposed to a dose of 22.5 KGy had a total thermophilic bacteria of 10 up to 7 months and increased to 55 after 9 months indicating that the irradiation dose of 22.5 KGy was effective for preservation of canned beef till 9 months without swelling. Such a count in CS cans was 10 up to 9 months of storage and reached 80 after 12 months. The total count of thermophilic bacteria in canned beef exposed to 45 KGy was less than 10 up to 9 months of storage and reaching 53 after 12 months, while in cans receiving a dose of 45 KGy it is similar to the CS cans after 12 months.

Effects of Gamma Irradiation on the Clostridium perfringens. From the Table it is clear that Clostridium perfringens was not detected neither in commercial heat sterilized beef nor in radiation-sterilized beef (45 KGy) all over storage periods. This indicates that these treatments were enough to assure safety. It was found in unirradiated cans and those receiving 11.25 and 22.5 KGy all over their storage periods. Such doses were not enough for its elimination meaning that irradiation dose of 18-30 KGy was required to inactivate these microorganisms. Lasta (1992) mentioned that Clostridium perfringens is a sporeforming bacteria and different doses were required to eliminate such forms and spores. They added that the vegetative forms were eliminated a by dose of 30 KGy, while for spores dose of 36 KGy (12 x 3KGy) was necessary. Food sterilization process must be able, at least, to destroy spores of Clostridium botulinum and the second of importance Clostridium perfringens or render them permanently inactive in that food. Irradiation doses for eliminating Clostridium botulinum and Clostridium perfringens would effectively destroy other pathogenic bacteria such as Salmonella spp. and Staphylococcus aureus as reported by Lambert and Maxcy, (1984) and Thayer and Boyd, (1993). It could be concluded that the irradiation dose of 45 was effective and sufficient in sterilizing similar to the CS. The tested bacterial counts were lower in 45 dose than in CS along the storage period.