PART (1)

"EFFECT OF GAMMA RADIATION ON TITRATABLE ACIDITY, pH AND SOME MICROORGANISMS"

EXPERIMENTAL

Samples of fresh cows' and buffaloes' milk were collected in sterilized reagent bottles then immediately cooled and kept in refrigerator until treatment. A pilot experiment was carried out on samples of cows milk irradiated at different doses of gamma radiation (200-550 Krad). The effect of milk radiation on acidity and pH was determined (Table 1). It was found that irradiation of milk at different doses has no effect on acidity and pH of the treated samples. After the prilimenary bacteriological examination, the dose 250 Krad was chosen and the effect of this dose on the pH and acidity of many cows' and buffaloes' milk samples were studied. This was carried out as follows:-

Each sample of cows' or buffaloes' milk was divided into two parts. The first was left unirradiated as control. The second sample was exposed to gamma radiation at 250 Krad.

Samples were irradiated in sterilized test tubes (1.5 x 17 cm) placed in a 1 liter beaker.

All samples were analyzed for titratable acidity, pH, total bacterial count (T.C.), Coliforms, Staphylococci, Lactobacilli, Lactic acid producer bacteria, Sporeformers as well as moulds and yeasts.

The effect of gamma radiation (250 Krad) on pH and acidity of cows milk is presented in Table (2). The maximum, minimum and mean of acidity and pH of irradiated cows milk as well as control are presented in Table (3). The respective data of buffaloes milk are presented in Tables (4) and (5), respectively.

Results recorded in Tables (2, 3, 4 and 5) show that no pronounced change occurred in the acidity and pH of cows and buffaloes milk due to the irradiation treatment (250 Krad).

In cows milk, the maximum, minimum and the mean of acidity of the irradiated samples were 0.23, 0.14 and 0.181,while those of control were 0.22, 0.14 and 0.18; respectively.

The maximum, minimum and the mean of the pH

Table (1):- Effect of different doses of gamma radiation on pH and acidity in cows' milk.

Samples No.	Dose (Krad)	Control (Non-radiated milk)		Radiated milk	
		Acidity	pH	Acidity	pH
1	250	0.17	6.60	0.18	6.50
	400	0.17	6.60	0.18	6.51
	550	0.17	6.60	0.18	6.50
2	200	0.18	6.40	0.18	6.30
	400	0.18	6.40	0.18	6.35
	550	0.18	6.40	0.18	6.30
3	200	0.18	6.45	0.18	6.40
	400	0.18	6.45	0.18	6.35
	500	0.18	6.45	0.18	6.40
4	200	0.20	6.10	0.21	6.00
	350	0.20	6.10	0.20	6.10
	470	0.20	6.10	0.20	6.10

Table (2):- Effect of gamma radiation (250 Krad) on pH and acidity of cows' milk.

Samples No.	Control (Non-radiated milk)		Radiated milk	
	Acidity	pH	Acidity	pH
1	0.16	6.68	0.17	6.70
2	0.20	6.60	0.20	6.70
3	0.18	6.58	0.18	6.55
4	0.20	6.50	0.18	6.48
5	0.15	6.57	0.16	6.70
6	0.18	6.55	0.18	6.59
7	0.19	6.71	0.18	6.70
8	0.19	6.55	0.19	6.57
9	0.17	6.68	0.17	6.69
10	0.16	6.58	0.16	6.55
11	0.20	6.50	0.20	6.50
12	0.20	6.46	0.21	6.45
13	0.21	6.46	0.21	6.46
14	0.16	6.60	0.17	6.56
15	0.18	6.58	0.18	6.58
16	0.18	6.58	0.18	6.58
17	0.14	6.84	0.14	6.83
18	0.18	6.60	0.19	6.54
19	0.18	6.53	0.17	6.50
20	0.19	6.61	0.19	6.59
21	0.19	6.55	0.18	6.54
22	0.16	6.65	0.17	6.63
23	0.17	6.53	0.16	6.55

values of irradiated cows' milk samples were 6.83, 6.46 and 6.581, respectively while the respective pH values of control were 6.84, 6.46 and 6.58.

In case of irradiated buffaloes' milk, the maximum, minimum and mean of acidity were 0.23, 0.16 and 0.192 and those of pH were 6.80, 6.32 and 6.62, while the respective values of control (non-irradiated milk) were 0.23, 0.15 and 0.19 for acidity and 6.85, 6.30 and 6.59 for pH, respectively.

The data concerning the effect of gamma radiation treatment (250 Krad) on the acidity and pH of cows' and buffaloes' milk is recorded in Tables (2, 3, 4 and 5) and illustrated in Figs.(1 and 2). Results show no marked changes in acidity and pH of milk due to the radiation treatment. This result is in agreement with the findings of Naghmoush et al., (1983) who observed that titratable acidity and pH of milk were not influenced by gamma radiation treatments (250, 500 and 750 Krad).

Table (3):- The maximum, minimum and mean values for acidity and pH in cows' milk.

	Control(Non-radiated milk)		Radiated milk	
	Acidity	pH	Acidity	pH
Maximum	0.22	6.84	0.23	6.83
Minimum	0.14	6.46	0.14	6.46
Mean	0.18	6.58	0.181	6.581

Table (4):- Effect of gamma radiation (250 Krad) on the pH and acidity of buffaloes' milk.

Samples No.	Control (Non-radiated milk)		Radiated milk	
	Acidity	pH	Acidity	pH
1	0.17	6.75	0.17	6.68
2	0.18	6.65	0.19	6.70
3	0.21	6.63	0.21	6.70
4	0.20	6.62	0.20	6.65
5	0.18	6.85	0.18	6.80
6	0.16	6.56	0.17	6.52
7	0.20	6.60	0.19	6.60
8	0.16	6.30	0.17	6.65
9	0.17	6.82	0.17	6.80
10	0.20	6.64	0.20	6.67
11	0.15	6.77	0.16	6.75
12	0.23	6.47	0.23	6.47
13	0.19	6.62	0.19	6.56
14	0.18	6.63	0.19	6.55
15	0.16	6.77	0.16	6.72
16	0.22	6.30	0.22	6.32
17	0.23	6.48	0.22	6.45
18	0.18	6.65	0.18	6.60
19	0.19	6.65	0.20	6.61

Table (5):- **The maximum, minimum and mean values for acidity and pH in buffaloes milk.**

	Control(Non-radiated milk)		Radiated milk	
	Acidity	pH	Acidity	pH
Maximum	0.23	6.85	0.23	6.80
Minimum	0.15	6.30	0.16	6.32
Mean	0.19	6.63	0.192	6.62

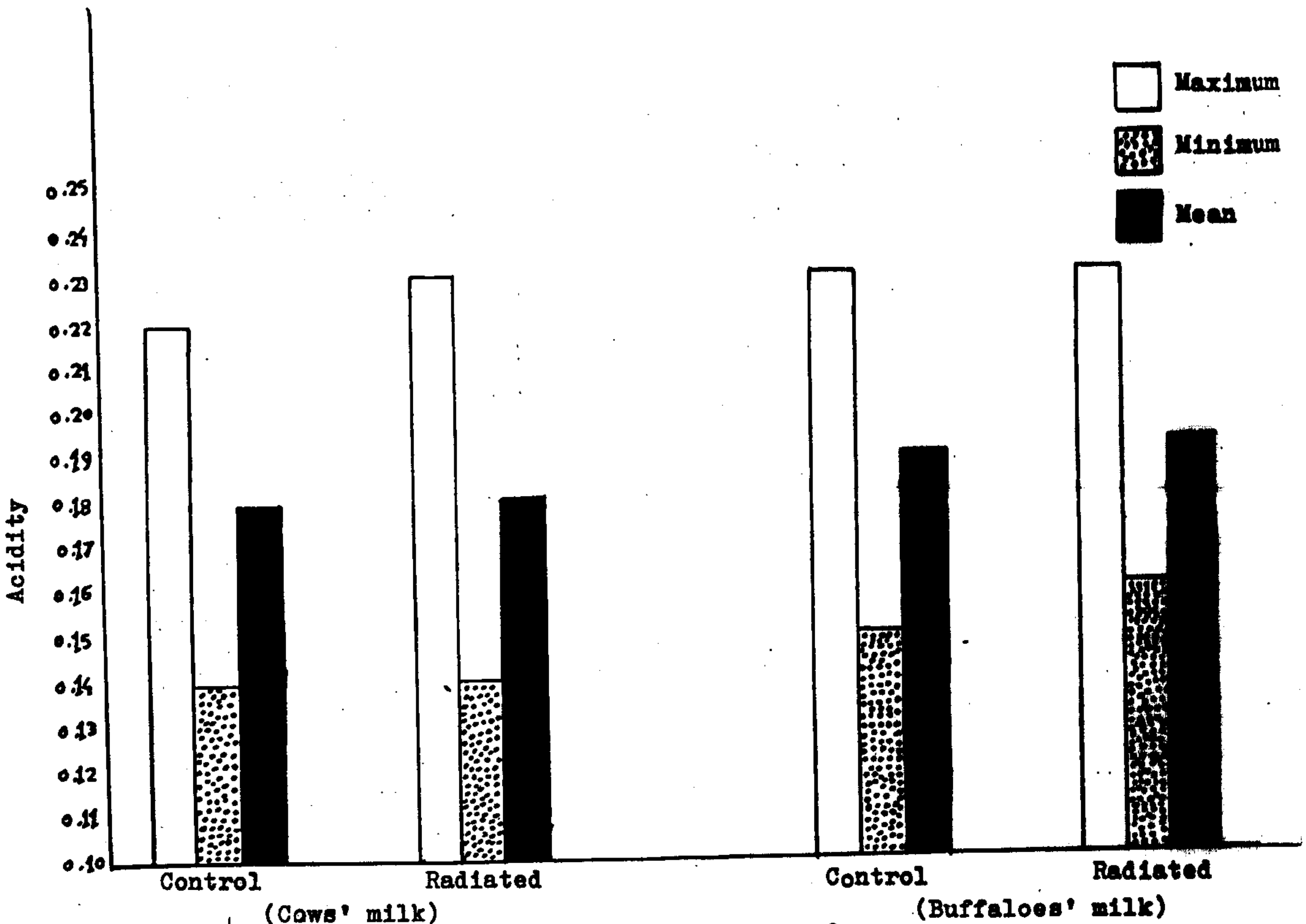

Fig. (1) The maximum, minimum and mean values for acidity in cows' and buffaloes' milk.

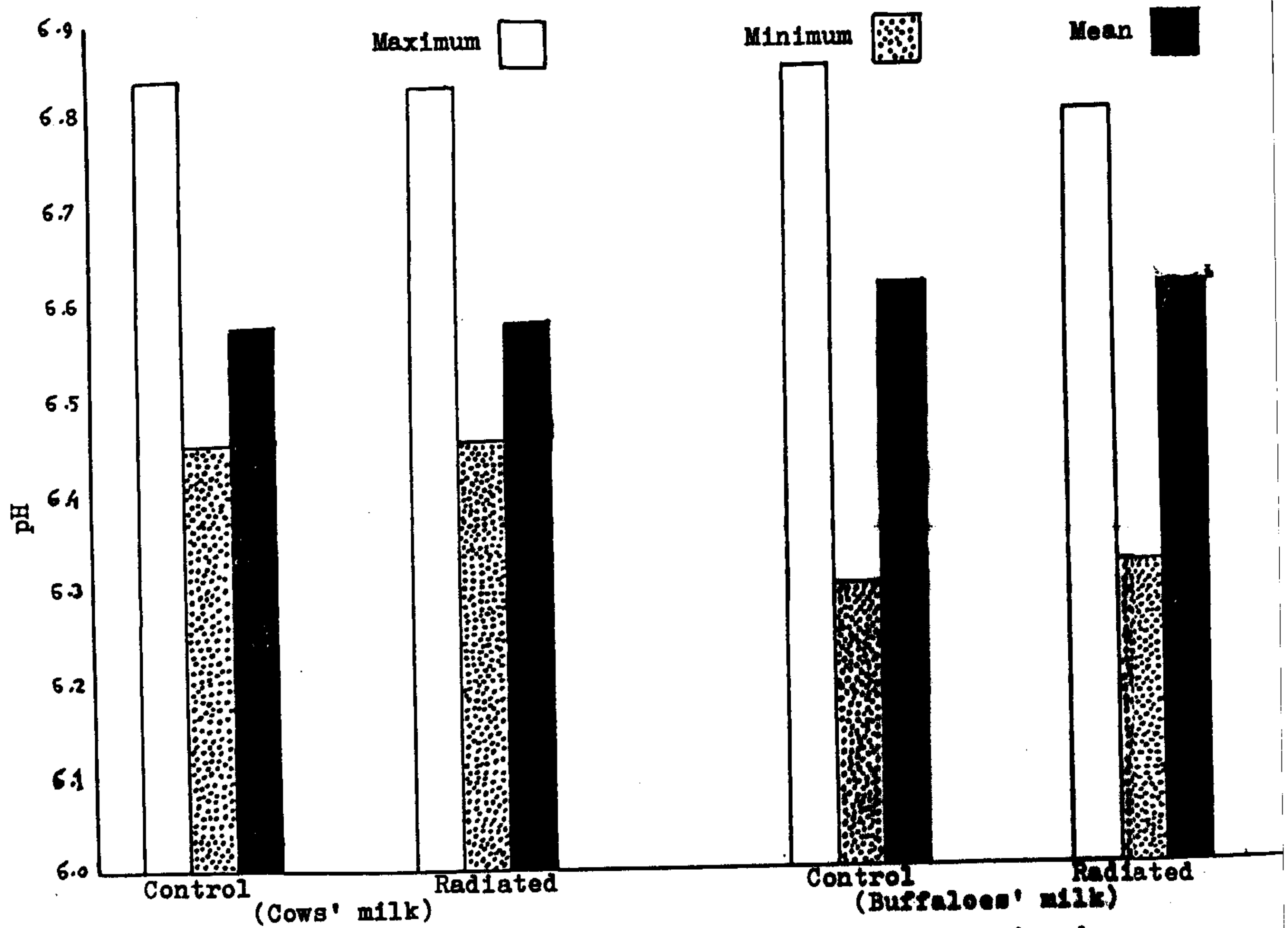

Fig. (2):- The maximum, minimum and mean values for pH in cows' and buffaloes' milk.

Effect of Different Doses of Gamma Radiation on Milk Microorganisms:

It is generally assumed that the death of microorganisms by ionizing radiation is a result of damage to DNA which carries the genetic information of the cell. The principal lesions induced by ionizing radiation in the DNA are the single and double strand breaks. The sensitivity of different species and strains of bacteria to irradiation differs greatly depending on its ability to repair the different damages caused by exposure to ionizing radiation. Most microorganisms are able to repair single strand breaks but it is generally believed that the more sensitive organisms to radiation cannot repair double strand breaks. It could be concluded that the radiation in resistance between microorganisms reffects differing abilities of cells to repair their radiation damaged DNA (Erdman et al., 1961; Thornley, 1963 and Moseley, 1968).

Table (6) shows the effect of different doses of radiation on total bacterial count.

Table (6):- Some trials on the effect of irradiation on total microbial counts in raw milk.

Trials	Dose (Krad)	Control (Non-radiated)	Rad-iated	% of des-truction
	250	$195x10^4$	$70x10^2$	99.640
1	400	$195x10^4$	30x10	99.985
	550	$195x10^4$	-	100
	200	$98x10^4$	$100x10^2$	98.979
2	400	$98x10^4$	50x10	99.948
	500	$98x10^4$	-	100
	200	$155x10^4$	$58x10^2$	99.625
3	350	$155x10^4$	40x10	99.974
	470	$155x10^4$	-	100

- = **No growth.**

The total bacterial count per 1 ml. was reduced from 195 x 10^4 in control (Non-radiated milk) to 70x10^2 and 30 x 10 at 250 and 400 Krad respectively; the percentages of destruction were 99.64 and 99.98%.

In another sample the total bacterial count per 1 ml. was reduced from 98 x 10^4 in control to 100 x 10^2, and 50 x 10 at 200 and 400 Krad and the rate of destruction for the aforementioned doses were 98.979 and 99.948% respectively.

In a third sample the total bacterial count per 1 ml. was reduced from 155 x 10^4 in raw milk (control) to 58 x 10^2 and 40 x 10 at 200 and 350 Krad, respectively. This corresponded to the percentages of destruction 99.625 and 99.974.

This is inagreement with Niewolak (1967) who observed that the treatment 400-500 Krad destroyed 99.996% of total bacterial count.

At higher radiation doses namely 470,500 and 550 Krad total microbial counts were completely destroyed.

Table (7) indicates that coliform bacteria were completely destroyed in milk irradiated at 200, 250,350, 400, 470, 500 and 550 Krad.

At 150 Krad the number of coliform bacteria per 1 ml was reduced from 42×10^3, 220×10^2 and 36×10^3 in raw milk samples (control) to be 30, 10 and 20 respectively, in the irradiated milk samples. The percentages of coliform destruction in these samples were 99.930, 99.954 and 99.944% respectively. These results are in agreement with Ingram and Farkas (1977) who reported that Gram-negative pathogens together with Escherichia coli and the associated members of the family Enterobacteriaceae, have low resistance to radiation.

Naghmoush et al., (1983) also observed that coliform bacteria were completely destroyed at the doses 250, 500 and 750 Krad.

Results in Table (8) indicate that gamma radiation have a severe destructive effect on the staphylococci

Table (7):- Some trials on the effect of irradiation on coliform bacteria in raw milk.

Trials	Dose (Krad)	Control (Non-radiated)	Rad-iated	%of des-truction
1	150	$42x10^3$	3x10	99.930
	250	$42x10^3$	-	100
	400	$42x10^3$	-	100
	550	$42x10^3$	-	100
2	150	$220x10^2$	10	99.954
	200	$220x10^2$	-	100
	400	$220x10^2$	-	100
	500	$220x10^2$	-	100
3	150	$36x10^3$	2x10	99.944
	200	$36x10^3$	-	100
	350	$36x10^3$	-	100
	470	$36x10^3$	-	100

- = No growth.

as well as moulds and yeasts.

The staphylococci were completely destroyed at doses 350, 400, 470, 500 and 550 Krad.

The number of colonies per 1 ml dropped from 30 x 10^4 in raw milk (control) to 70 in irradiated milk at 200 Krad and the rate of destruction was 99.976%.

While the number of Staphylococci was reduced from 70 x 10^3 in raw milk (control) to 10 in irradiated milk at 250 Krad and the percentage of Staph.destruction was 99.985%.

These results are inagreement with Erdman et al., (1961) who found that 200-300 Krad were sufficient to reduce Staph.aureus count a million-fold. While Quinn et al., (1966) found that 1000-2000 Krad were required to do the same effect. This variation was due to the strain of Staph.aureus used in the irradiation.

Table (8) also shows that the moulds and yeasts were destroyed at doses 250, 350, 400, 470, 500 and 550 Krad. But at 200 Krad, the number of moulds

Table (8):- Some trials on the effect of irradiation on Staphylococci, Moulds and yeasts in raw milk.

Trails	Dose Krad	Staphylococci			Moulds & Yeasts		
		Control(Non-radiated)	Rad-iated	%of des-truction	Control(Non-radiated)	Rad-iated	%of des-truction
1	250	$70x10^3$	10	99.985	33x10	-	100
	400	$70x10^3$	-	100	33x10	-	100
	550	$70x10^3$	-	100	33x10	-	100
2	200	$30x10^4$	70	99.976	110x10	6	99.45
	400	$30x10^4$	-	100	110x10	-	100
	500	$30x10^4$	-	100	110x10	-	100
3	200	$180x10^2$	-	100	$22x10^2$	10	99.55
	350	$180x10^2$	-	100	$22x10^2$	-	100
	470	$180x10^2$	-	100	$22x10^2$	-	100

- = No growth.

and yeasts per 1 ml milk dropped from 11 x 10^2 and 22 x 10^2 in raw milk samples (control) to 6 and 10 colonies/ ml. in irradiated milk. The percentage of destruction were 99.45 and 99.55% respectively.

This result is inagreement with the findings of Naghmoush et al., (1983) who observed that moulds and yeasts were completely destroyed with all selected doses (250, 500 and 750 Krad).

Table (9) shows the effect of different doses of gamma radiation on lactic acid bacteria and Lactobacilli. At doses 470, 500 and 550 Krad Lactic acid bacteria and Lactobacilli were completely destroyed. However, at 200 Krad the number of Lactobacilli per 1 ml. milk dropped from 99 x 10^4, 105 x 10^4 and 53 x 10^3 in control (Non-irradiated milk) to 85 x 10, 100 x 10 and 33/ml, respectively in irradiated milk. The rate of Lactobacilli destruction in the aforementioned samples were 99.914, 99.90 and 99.93%, respectively, at 200 Krad.

Table(9):- Some trials on the effect of irradiation on Lactobacilli and lactic acid producers in raw milk.

Trials	Dose Krad	Lactobacilli			Lactic acid producers		
		Control(Non-radiated)	Rad-iated	%of des-truction	Control(Non-radiated)	Rad-iated	%of des-truction
1	200	$99x10^4$	85x10	99.914	$103x10^4$	170	99.98
	400	$99x10^4$	-	100	$103x10^4$	-	100
	550	$99x10^4$	-	100	$103x10^4$	-	100
2	200	$105x10^4$	100x10	99.90	$150x10^4$	200	99.98
	400	$105x10^4$	100	99.99	$150x10^4$	-	100
	500	$105x10^4$	-	100	$150x10^4$	-	100
3	200	$53x10^3$	33	99.93	$160x10^3$	60	99.962
	350	$53x10^3$	-	100	$160x10^3$	-	100
	470	$53x10^3$	-	100	$160x10^3$	-	100

- = No growth.

Concerning Lactic acid bacteria, higher doses than 200 Krad completely destroyed these bacteria. But at 200 Krad, the number of lactic acid bacteria per 1 ml milk dropped from 103×10^4, 150×10^4 and 160×10^3 in control (Non-radiated milk) to 170, 200 and 60/ml., respectively in irradiated milk. This corresponded to destruction rates of 99.98, 99.98 and 99.96%, respectively, at 200 Krad. These results are inagreement with Niven (1958) who found that 200-300 Krad reduced Lactobacillus count a million-fold.

The dose 250 Krad will be used in the following experiments because this dose destroys the majority of microorganisms present in milk (more than 95%) and hence prolongs the keeping quality of the irradiated milk and to avoid the deleterious effect of the high doses on the organoleptic properties.

Effect of Gamma Radiation (250 Krad) on Microorganisms of Milk:

1. **Effect of gamma radiation (250 Krad) on total bacterial count of milk:**

Data in Table (10) indicate the effect of gamma radiation on total bacterial count in 22 samples of cows milk. Results obtained in Table (10) show that microorganisms, in cows milk, were completely destroyed by irradiation when the original counts were low. The total bacterial counts were completely destroyed in cows milk samples having the counts 250×10^2, 72×10^3 and 150×10^3/ml. and the percentages of destruction for these samples were 100%.

Table (11) and Figure (6) represent the maximum, minimum, and mean values for total bacterial count in cows' milk. The maximum total count in cows milk was 45×10^6, the minimum was 250×10^2 and the mean was 116×10^5/ml milk in the control (non-irradiated milk); while their respective values in the irradiated milk samples were 40×10^4, 0.0 and 34×10^3/ml. The maximum, minimum and mean rates of microbial destruction due to

Table (10):- Effect of gamma radiation (250 Krad) on total bacterial count in cows milk.

SamplesNo.	Control(Non-radiated)	Radiated	%of destruction
1	$31x10^4$	20x10	99.935
2	$60x10^4$	$15x10^2$	99.750
3	$45x10^4$	$12x10^2$	99.733
4	$100x10^4$	$22x10^2$	99.780
5	$135x10^4$	$60x10^3$	95.555
6	$170x10^4$	$70x10^3$	95.882
7	$47x10^5$	$145x10^2$	99.691
8	$250x10^2$	-	100
9	$72x10^3$	-	100
10	$150x10^3$	-	100
11	$45x10^6$	$120x10^3$	99.733
12	$260x10^5$	$114x10^2$	99.991
13	$243x10^5$	$20x10^2$	99.991
14	$36x10^6$	$40x10^4$	98.888
15	$167x10^3$	$25x10^2$	98.502
16	$185x10^4$	$30x10^2$	98.378
17	$36x10^6$	22x10	99.993
18	$150x10^4$	80	99.994
19	$95x10^5$	$30x10^2$	99.968
20	$195x10^5$	$51x10^2$	99.973
21	$71x10^5$	$100x10^2$	99.948
22	$38x10^6$	$98x10^3$	99.703

- = **No growth.**

Table (11):- The maximum, minimum and mean values for total bacterial count in cows' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$45x10^6$	$40x10^4$	100
Minimum	$250x10^2$	0.0	95.55
Mean	$116x10^5$	$34x10^3$	99.335

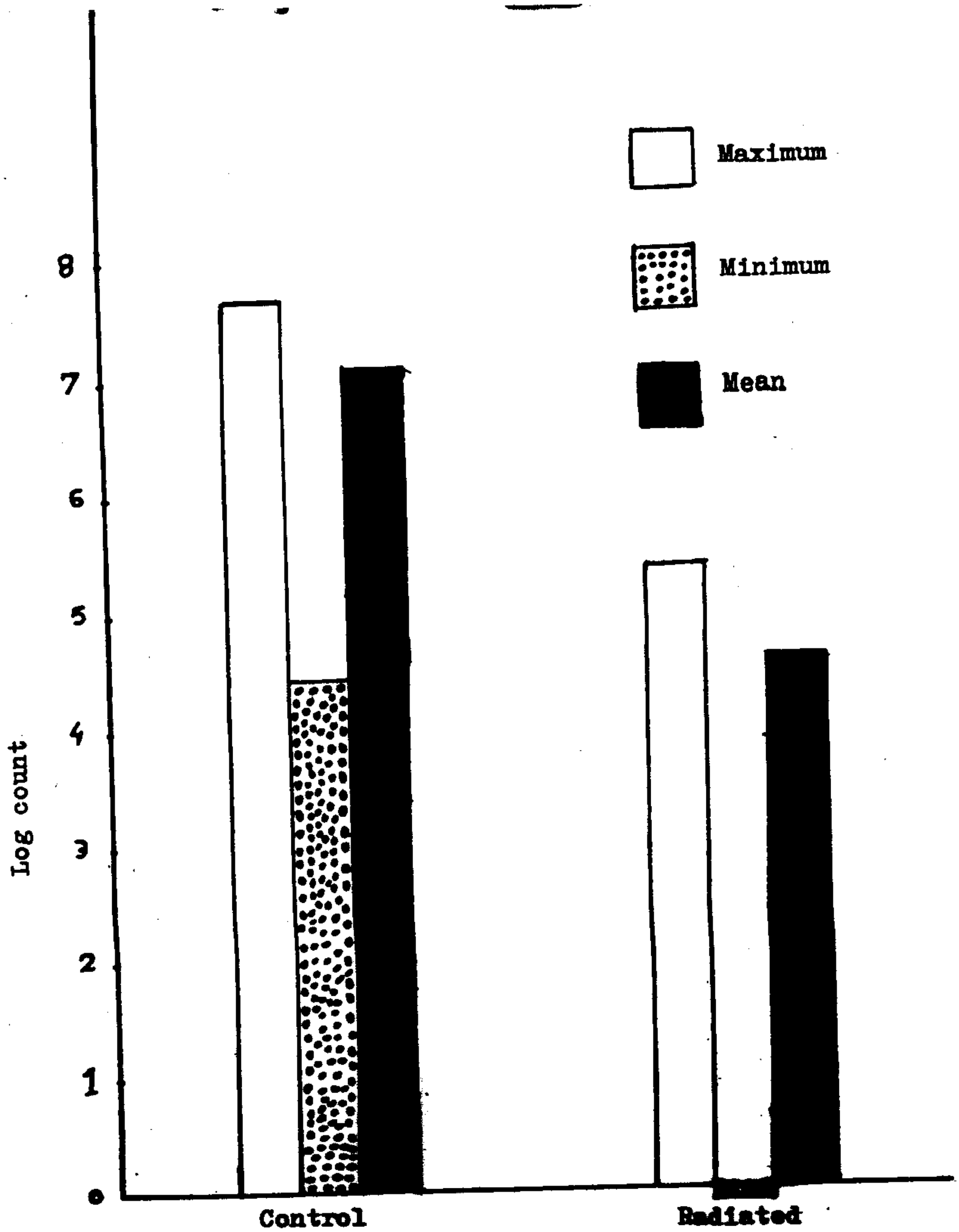

Fig. (3):- The maximum, minimum and mean values for total bacterial count in cows' milk.

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radiation were 100, 95.55 and 99.335%, respectively.

The effect of gamma radiation on total bacterial count in 21 samples of buffaloes milk is recorded in Table (12). The maximum, minimum and mean of total bacterial counts in buffaloes' milk are presented in Table (13) and illustrated by Figure (4).

As in the case of cows' milk, microorganisms of buffaloes' milk samples, having low counts (160×10^3, 251×10^2 and 47×10^3), were completely destroyed by irradiation. The maximum, minimum and mean of total count of buffaloes' milk were 210×10^5, 251×10^2 and 32×10^5/ml., respectively, in the control. While after irradiated of milk, the maximum, minimum and mean of counts were 50×10^3, 0.0 and 59×10^2, respectively. The maximum, minimum and mean of the percentages of bacterial destruction in buffaloes' milk due to radiation were 100%,97.647%, and 99.69% respectively.

Table (12):- Effect of gamma radiation (250 Krad) on total bacterial count in buffaloes' milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$42x10^4$	$10x10^2$	99.761
2	$35x10^4$	$10x10^2$	99.714
3	$250x10^3$	$7x10^2$	99.720
4	$160x10^3$	-	100
5	$150x10^4$	$20x10^2$	99.866
6	$42x10^5$	$20x10^3$	99.523
7	$57x10^4$	$40x10^2$	99.298
8	$85x10^4$	$20x10^3$	97.647
9	$150x10^5$	$33x10^2$	99.978
10	$52x10^5$	$25x10^2$	99.951
11	$200x10^4$	90x10	99.955
12	$52x10^4$	$20x10^2$	99.615
13	$83x10^5$	$30x10^2$	99.638
14	$251x10^2$	-	100
15	$36x10^5$	210x10	99.914
16	$47x10^3$	-	100
17	$210x10^3$	36x10	99.828
18	$253x10^3$	15x10	99.911
19	$170x10^4$	150x10	99.911
20	$20x10^5$	$100x10^2$	99.500
21	$210x10^5$	$50x10^3$	99.761

- = No growth.

Table (13):- The maximum, minimum and mean values for total bacterial count in buffaloes milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$210x10^5$	$50x10^3$	100
Minimum	$251x10^2$	0.0	97.647
Mean	$32 x10^5$	$59x10^2$	99.69

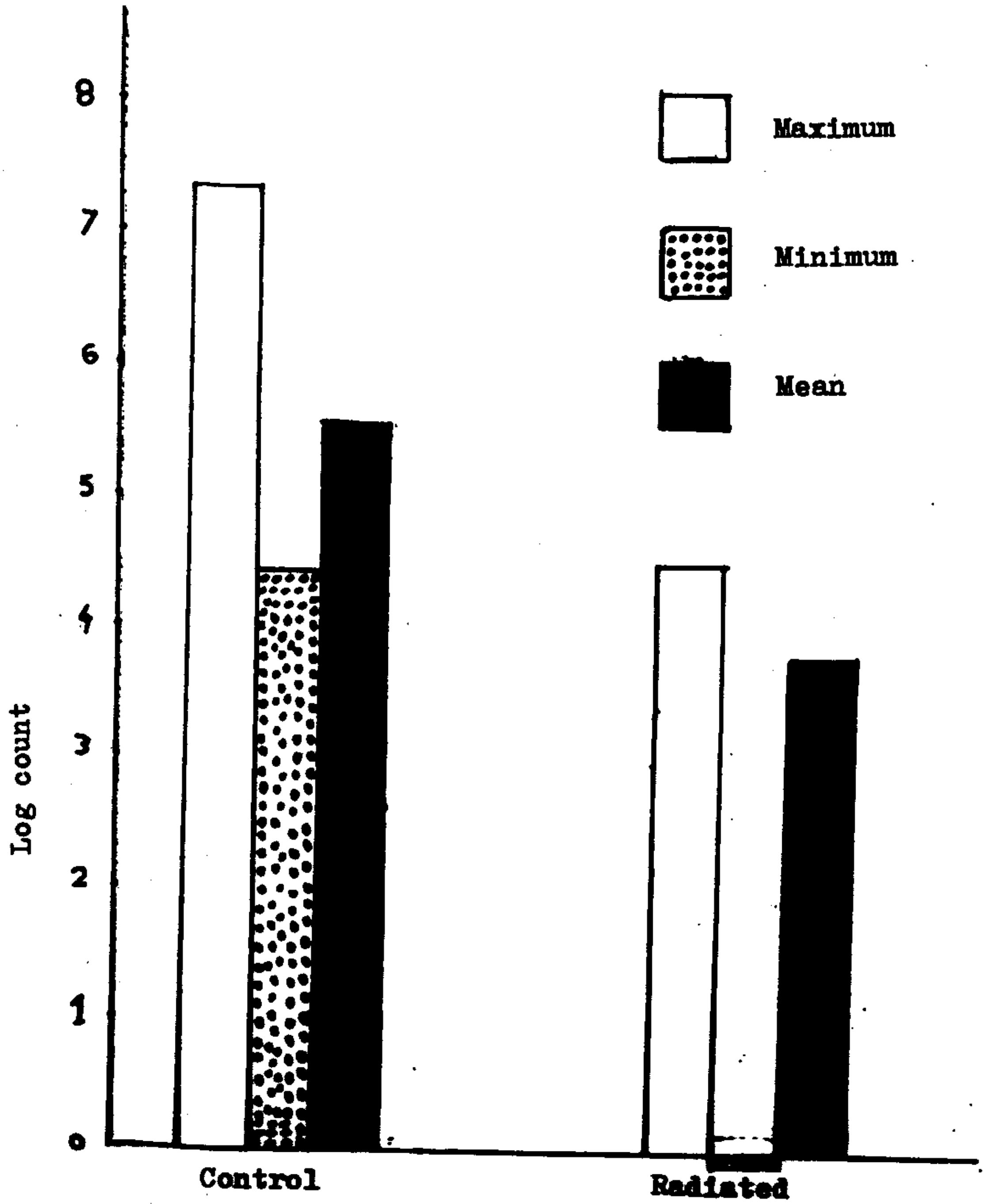

Fig. (4):- The maximum, minimum and mean values of total bacterial count in buffaloes' milk.

These results are in agreement with Freeman, Barbara (1959) who observed that the total bacterial count and Coliforms were greatly reduced by gamma radiation doses 0.25, 0.50, 0.75, 1.0 and 1.25 Mrad. Niewolak (1967) also found that 90-100 Krad destroyed 99% of total bacterial count.

The results are also in accordance with the findings of Naguib et al., (1973) who observed a drastic drop in total bacterial count in buffaloes' milk due gamma radiation treatment.

2. <u>Effect of gamma radiation on some bacteria</u>:

A) <u>Effect of gamma radiation on coliform bacteria</u>:

The effect of gamma radiation(170 Krad) on cows' milk (20 samples) is recorded in Table (14).

Table (15) and Figure (5) show the maximu,minimum and the mean of coliform bacteria counts in cows' milk which were 230 x 10^4, 100 and 189 x 10^3/ml., respectively in the control but these counts were completely destroyed at 170 Krad. The percentages of coliforms destruction were 100% in all investigated samples.

The effect of gamma radiation (170 Krad)on buffaloes' milk (20 samples) is recorded in Table (16). Table (I7) and Figure (6)show the maximum,minimum and the mean of coliform bacteria counts in buffaloes' milk which were 56 x 10^3, 120 and 185 x 10^2, respectively in the control. But all coliform counts in buffaloes' milk were completely destroyed by irradiating the milk at 170 Krad.

As in the case of cows' milk, the rate of coliforms destruction in buffaloes' milk due to radiation was 100% in all investigated samples.

Table (14):- Effect of gamma radiation (170 Krad) on coliform bacteria in cows' milk.

Samples No.	Control (Non-radiated)	Radiated	% of destruction
1	$35x10^3$	-	100
2	$27x10^3$	-	100
3	$170x10^3$	-	100
4	90x10	-	100
5	100	-	100
6	120x10	-	100
7	$190x10^2$	-	100
8	$290x10^3$	-	100
9	$57x10^2$	-	100
10	100	-	100
11	$45x10^2$	-	100
12	$230x10^4$	-	100
13	$57x10^2$	-	100
14	36x10	-	100
15	96x10	-	100
16	20x10	-	100
17	$45x10^4$	-	100
18	$68x10^3$	-	100
19	$250x10^3$	-	100
20	$157x10^3$	-	100

- = No growth.

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Table (15):- The maximum, minimum and mean values for coliform bacteria in cows' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$230x10^4$	0.0	100
Minimum	100	0.0	100
Mean	$189x10^3$	0.0	100

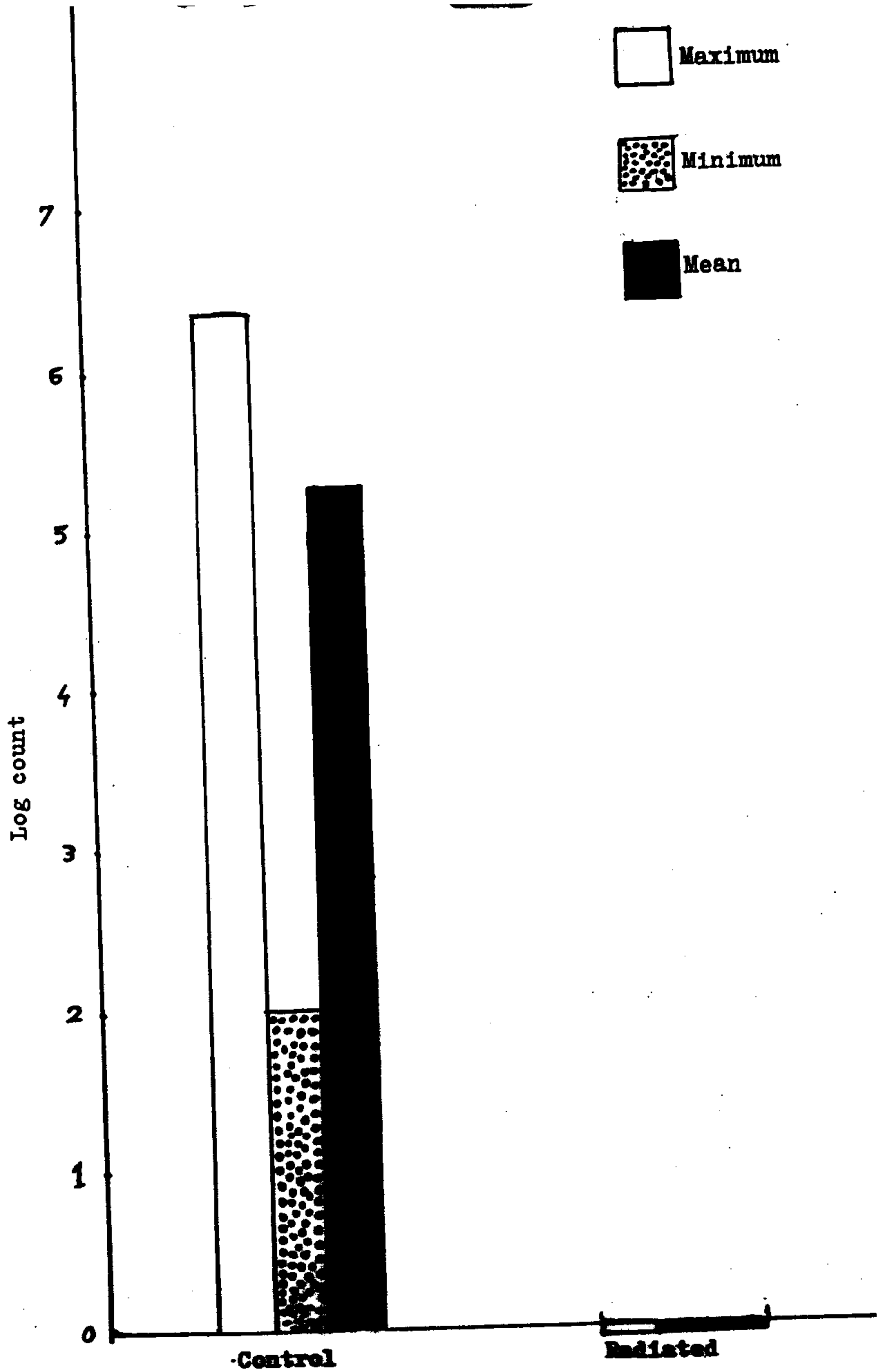

Fig. (5):- The maximum, minimum and mean values for coliform bacteria in cows' milk.

Table (16):- Effect of gamma radiation (170 Krad) on coliform bacteria in buffaloes' milk.

Samples No.	Control (Non-radiated)	Radiated	% of destruction
1	$120x10^2$	-	100
2	$27x10^3$	-	100
3	$65x10^2$	-	100
4	30x10	-	100
5	$42x10^2$	-	100
6	$37x10^3$	-	100
7	$34x10^3$	-	100
8	$36x10^3$	-	100
9	$56x10^3$	-	100
10	$40x10^3$	-	100
11	20x10	-	100
12	$55x10^2$	-	100
13	$47x10^3$	-	100
14	30x10	-	100
15	120	-	100
16	88x10	-	100
17	$75x10^2$	-	100
18	$43x10^3$	-	100
19	$52x10^2$	-	100
20	$65x10^2$	-	100

- = **No growth.**

Table (17):- The maximum, minimum and mean values for coliform bacteria in buffaloes' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$56x10^3$	0.0	100
Minimum	120	0.0	100
Mean	$185x10^2$	0.0	100

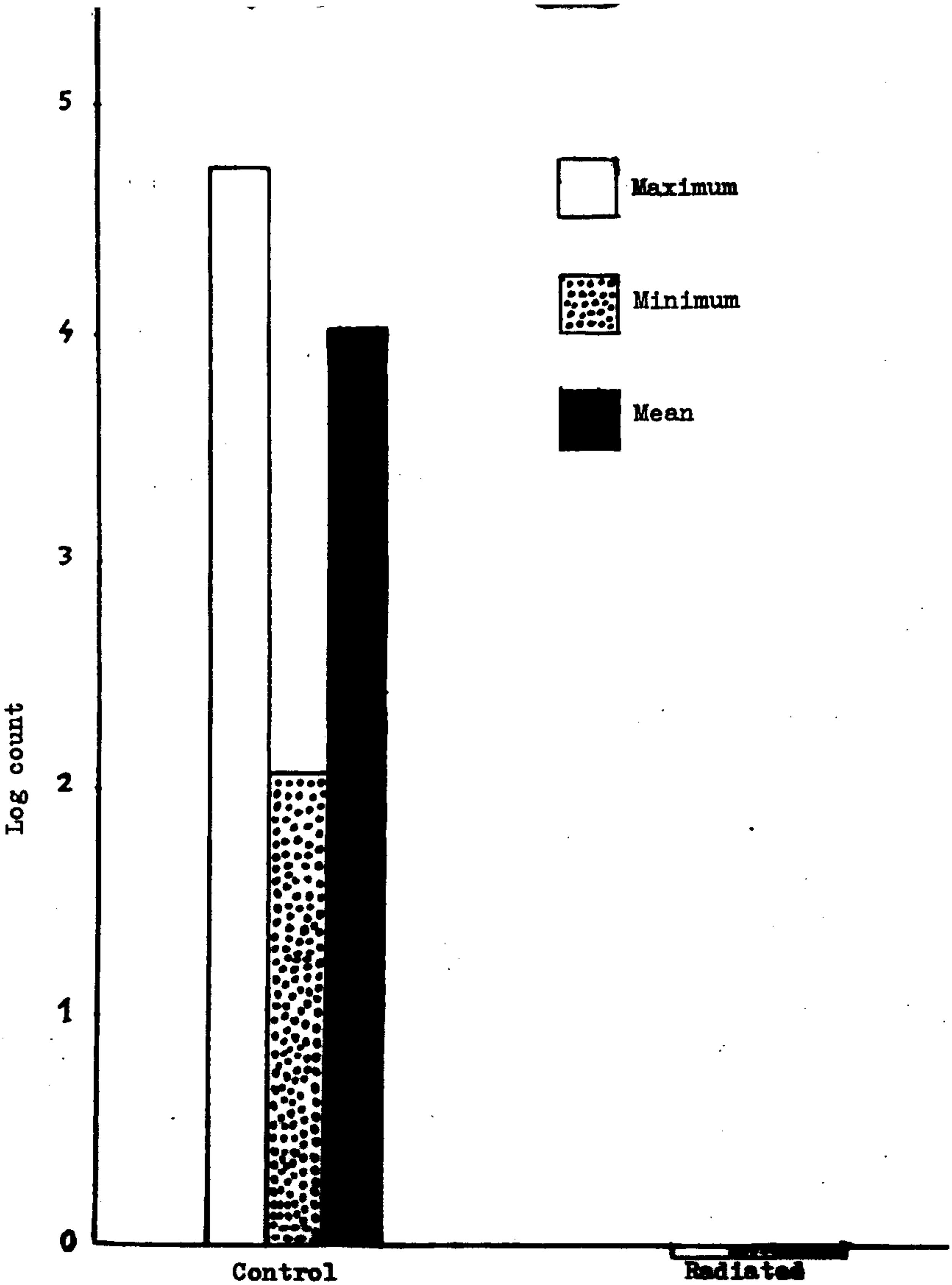

Fig. (6):- The maximum, minimum and mean values for coliform bacteria in buffaloes' milk.

From the above results it could be concluded that coliform bacteria present in cows' or buffaloes' milk were destroyed by irradiating milk at 170 Krad.

These results are inagreement with the findings of Dluzewski and Pijanowski (1964) who found that the number of coliform bacteria in raw milk was reduced to 0.1% at dose 0.1 to 0.13 Mrad, while a dose 0.13 to 0.17 Mrad approximately reduced coliform counts to 0.01% of original number. Umanskii et al., (1974) found that coliform bacteria were killed at 0.0ç1 Mrad at 20 ± 1°C. Naguib et al., (1973), reported the complete destruction of coliforms in buffaloes' milk by gamma radiation. Also these results are in accordance with the findings of Naghmoush et al., (1983) who found that coliforms, yeasts and molds were completely destroyed by all selected doses of gamma radiation (250, 500 and 750 Krad).

B) Effect of gamma radiation on Staphylococci:

Table (18) shows the effect of gamma radiation (250 Krad) on Staphylococci in cows' milk.

Data in Table (18) indicate that the irradiation of cows' milk containing low counts of staphylococci($x10^2$ and $x10^3$) completely destroyed the staphylococci present. Samples of cows' milk containing moderate counts of staphylococci namely 100×10^3, 35×10^3 and 37×10^3; the counts dropped to be 400, 200 and 500/ml., respectively, after irradiation.

The respective percentages of destruction were 99.6, 99.428 and 98.648%. The number of staphylococci per 1 ml dropped from 37×10^4, 131×10^4, 212×10^4, 33×10^4 and 35×10^4 in control samples to 100, 500,700 300 and 300/ml., respectively, after irradiation. This corresponded to percentages of destruction 99.927,99.681, 99.66, 99.90 and 99.428%, respectively.

Table (19) and Figure (7) show that the maximum, minimum and mean of staphylococci counts in the control

Table (18):- Effect of gamma radiation (250 Krad) on Staphylococci in cows' milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$100x10^3$	400	99.60
2	$35x10^3$	200	99.428
3	$80x10^2$	-	100
4	$37x10^3$	500	98.648
5	$41X2\ x10^3$	-	100
6	$190x10^3$	-	100
7	$37x10^4$	100	99.927
8	$35x10^3$	-	100
9	$215x10^2$	-	100
10	$50x10^3$	-	100
11	$70x10^3$	-	100
12	$200x10^3$	-	100
13	$60x10^3$	-	100
14	$52x10^2$	-	100
15	$131x10^4$	500	99.618
16	$50x10^2$	-	100
17	$212x10^4$	700	99.966
18	$230x10^2$	-	100
19	$70x10^2$	-	100
20	$33x10^4$	300	99.90
21	$35x10^4$	300	99.914
22	$240x10^2$	-	100

- = **No growth.**

Table (19):- The maximum, minimum and mean values for Staphylococci in cows milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$212x10^4$	700	100
Minimum	$50x10^2$	0.0	99.43
Mean	$245x10^3$	131	99.94

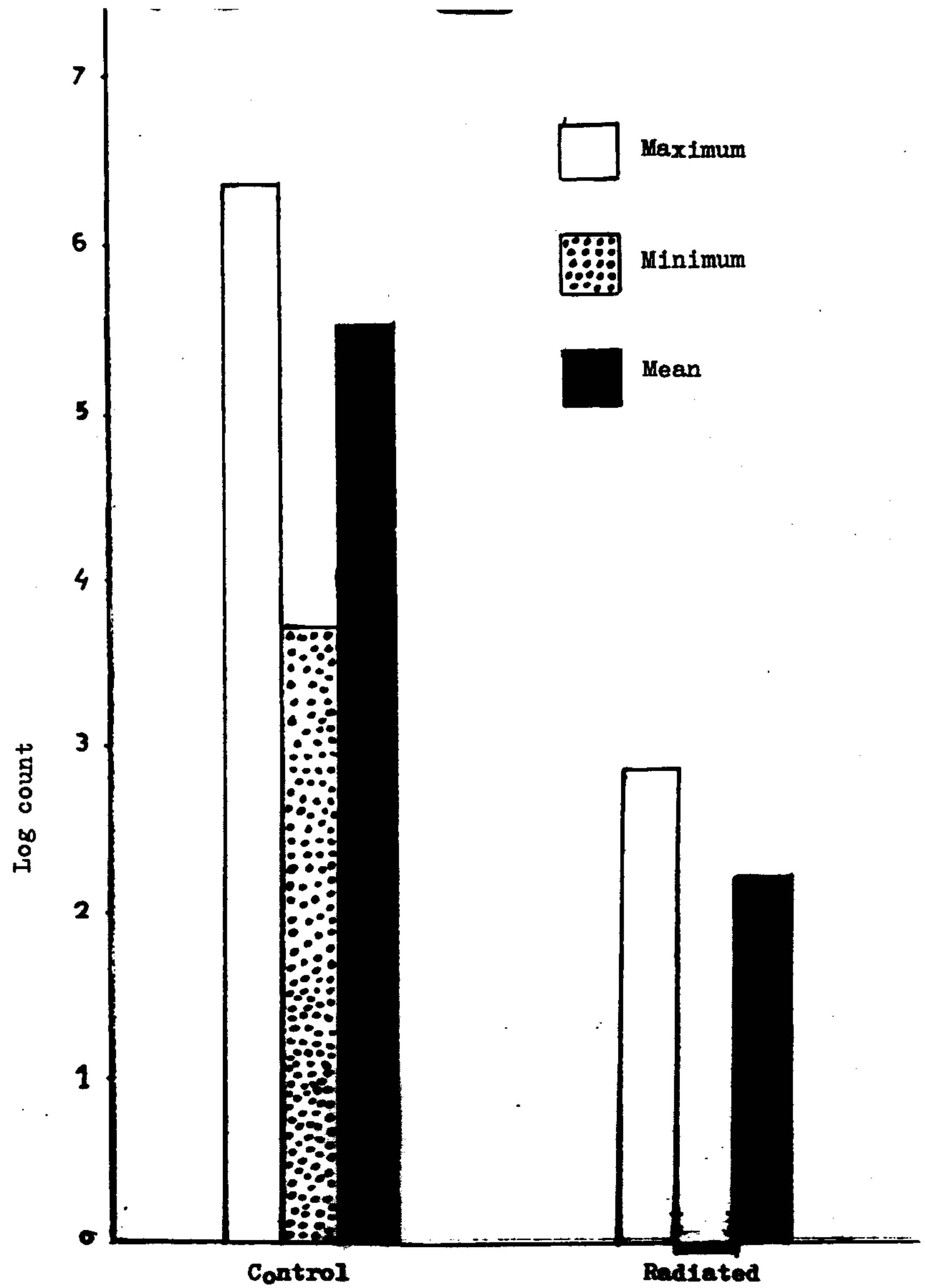

Fig. (7):- The maximum, minimum and mean values for Staphylococci in cows' milk.

of cows' milk were 212 x 10^4, 50 x 10^2 and 245 x 10^3 per 1 ml., respectively. When milk samples were irradiated the staph. maximum, minimum and mean were 700, 0.0 and 131/ml., respectively. The maximum rate of destruction was 100, the minimum was 99.43 and mean was 99.94%, respectively.

The effect of gamma radiation (250 Krad) on Staphylococci in buffaloes' milk is recorded in Table (20). Results in Table (20) show that low staph. counts were completely destroyed by irradiation and moderate staph. counts were reduced. The number of staph per 1 ml.dropped from (x 10^3) 250, 37, 40, 35, 45, 42 and 35 in the control to (x 10) 70, 10, 50, 10, 160 and 10/ml., respectively in irradiated milk.

This corresponded to percentages of staph. destruction of 99.72, 99.729, 98.750, 99.714, 96.444, 99.761 and 99.714%, respectively.

The number of staph. was reduced from 48 x 10^4/ml. in the control to 30 x 10 in the irradiated milk and rate of destruction was 99.94%.

Table (20):- Effect of gamma radiation (250 Krad) on Staphylococci in buffaloes milk.

Samples No.	Control (Non-radiated	Radiated	% of destruction
1	$60x10^3$	-	100
2	$250x10^3$	70x10	99.720
3	$37x10^3$	10x10	99.729
4	$40x10^3$	50x10	98.75
5	$33x10^3$	-	100
6	$32x10^3$	-	100
7	$35x10^3$	10x10	99.714
8	$45x10^3$	160x10	96.444
9	$42x10^3$	10x10	99.761
10	$30x10^3$	-	100
11	$33x10^3$	-	100
12	$35x10^3$	10x10	99.714
13	$31x10^3$	-	100
14	60x10	-	100
15	$172x10^2$	-	100
16	$69x10^2$	-	100
17	$200x10^2$	-	100
18	$50x10^3$	-	100
19	$48x10^4$	30x10	99.937
20	$20x10^3$	-	100

- = No growth.

Table (21) and Figure (8) show that the maximum staphylococci counts, minimum, and mean in control of buffaloes' milk, respectively were 48×10^4, 60×10 and 65×10^3; While in radiated milk, respectively, were 160×10, 0.0 and 17.5×10.

The maximum, minimum and mean rate of destruction were 100, 96.44 and 99.69%, respectively.

These results are inagreement with Niven (1958) who found that a dose $<$ 50 Krad reduced Staph.aureus counts a million fold. Also, Erdman et al., (1961) found that the doses 200-300 Krad reduced Staph.aureus counts a million-fold.

Table (21):- The maximum, minimum and mean values for Staphylococci in buffaloes milk.

Bacterial content	Control (non-radiated)	Radiated	%of destruction
Maximum	$48x10^4$	160x10	100
Minimum	60x10	0.0	96.444
Mean	$65x10^3$	17.5x10	99.69

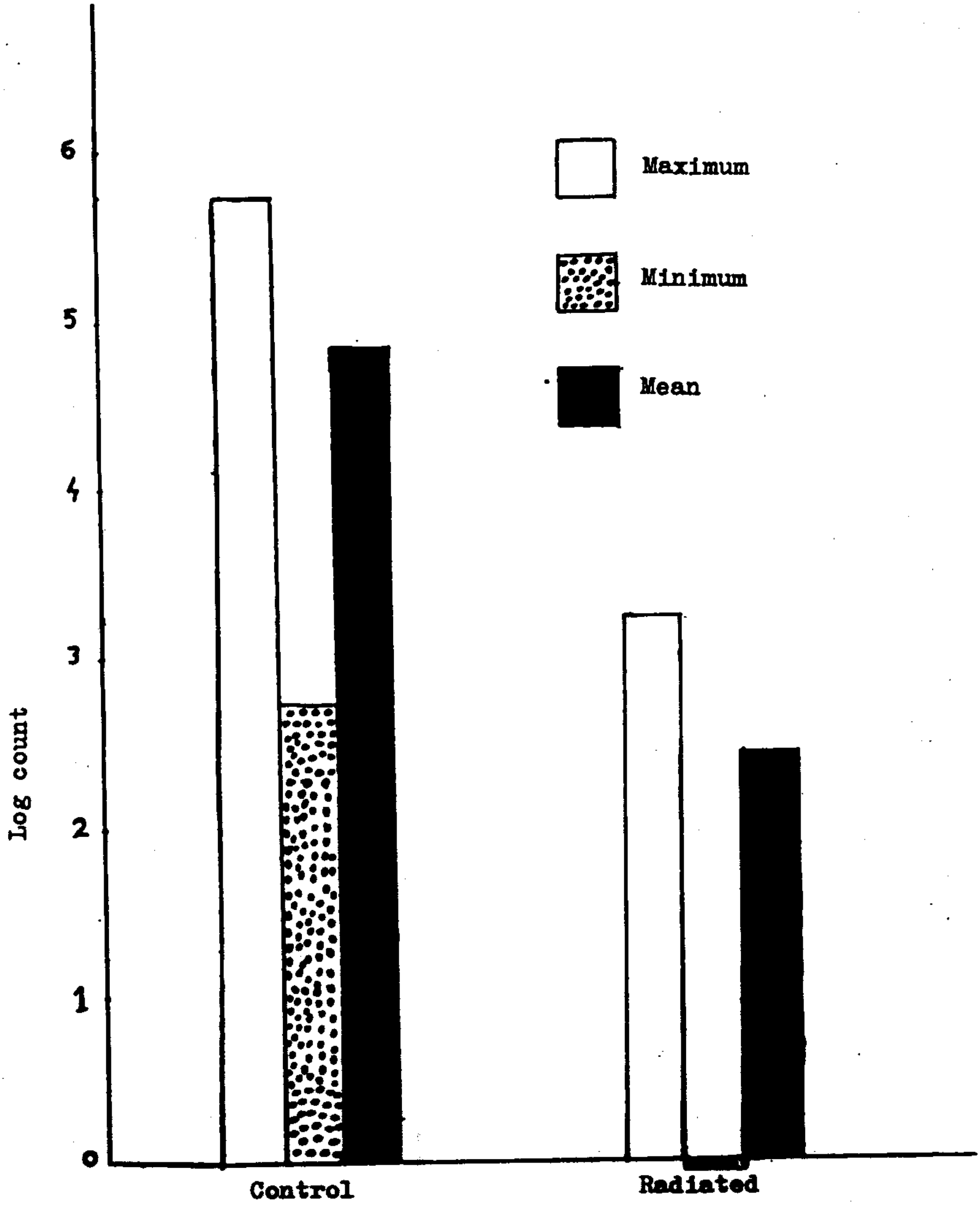

Fig. (8):- The maximum, minimum and mean values for Staphylococci in buffaloes' milk.

3. <u>Effect of gamma radiation (250 Krad) on lactic acid bacteria:</u>

The effect of gamma radiation (250 Krad) on lactic acid bacteria in cows' milk is reported in Table (22). It appears that the counts of lactic acid bacteria per 1 ml. ($x\ 10^2$) 100, 100, 10, 130 and 42 $x\ 10^3$ in control were completely destroyed by irradiation. The percentages of destruction were 100%.

The number per 1 ml was reduced from ($x\ 10^2$) 182, in the control to 30/ml. in irradiated milk and the rate of destruction was 99.983%. While the number per 1 ml. in control samples ($x\ 10^3$) 60, 110, 48, 70, 48, 185 and 240, were reduced to (x 10) 5, 6, 20, 37, 20, 50 and 44 $x\ 10^2$, réspectively, in irradiated milk. This corresponded the following percentages of destruction 99.916,99.945, 99.583, 99.471, 99.583, 99.792 and 98.166%, respectively.

The counts of lactic acid bacteria per 1 ml dropped from ($x\ 10^4$) 50, 80, 33, 35, 32, 76, 203 and 35 in the control to ($x\ 10^2$)70, 210, 200, 176, 98, 230, 13 and 10, respectively in irradiated milk. The percentages of

Table (22):- Effect of gamma radiation (250 Krad) on Lactic acid producers bacteria in cows' milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$60x10^3$	5x10	99.916
2	$110x10^3$	6x10	99.945
3	$48x10^3$	20x10	99.583
4	$50x10^4$	$70x10^2$	97.60
5	$70x10^3$	37x10	99.471
6	$182x10^2$	3x10	99.983
7	$80x10^4$	$210x10^2$	97.375
8	$100x10^2$	-	100
9	$48x10^3$	20x10	99.583
10	$33x10^4$	200x10	99.393
11	$100x10^2$	-	100
12	$130x10^5$	$210x10^2$	99.838
13	$10x10^2$	-	100
14	$130x10^2$	-	100
15	$35x10^4$	$176x10^2$	94.497
16	$240x10^3$	$44x10^2$	98.166
17	$250x10^5$	$197x10^2$	99.921
18	$203x10^4$	130x10	99.935
19	$185x10^3$	50x10	99.792
20	$32x10^4$	$98x10^2$	99.693
21	$76x10^4$	$230x10^2$	96.973
22	$35x10^4$	100x10	99.714
23	$42x10^3$	-	100

- = No growth.

destruction were 98.60, 97.373, 99.393, 94.497, 99.693, 99.973, 99.935 and 99.714%, respectively.

The higher lactic acid bacterial counts were reduced from (x 10^5) 130 and 250 in control to (x 10^2) 210 and 197/ml. in irradiated milk with percentages of destruction of 99.838 and 99.921%, respectively.

Table (23) and Figure (9) show that the maximum of lactic acid bacterial counts, the minimum, and mean, respectively, were 250 x 10^5, 10 x 10^2 and 193 x 10^4 in control; while in irradiated milk were 230 x 10^2, 0.0 and 56 x 10^2, respectively.

The maximum, minimum and mean percentages, of destruction were 100, 96.973 and 99.44%, respectively.

Data in Tables (24) and (25) and Figure (10) indicate the effect of gamma radiation (250 Krad) on lactic acid bacteria in buffaloes' milk.

Results in Table (24) indicate that gamma irradiation has a destructive effect on the lactic acid

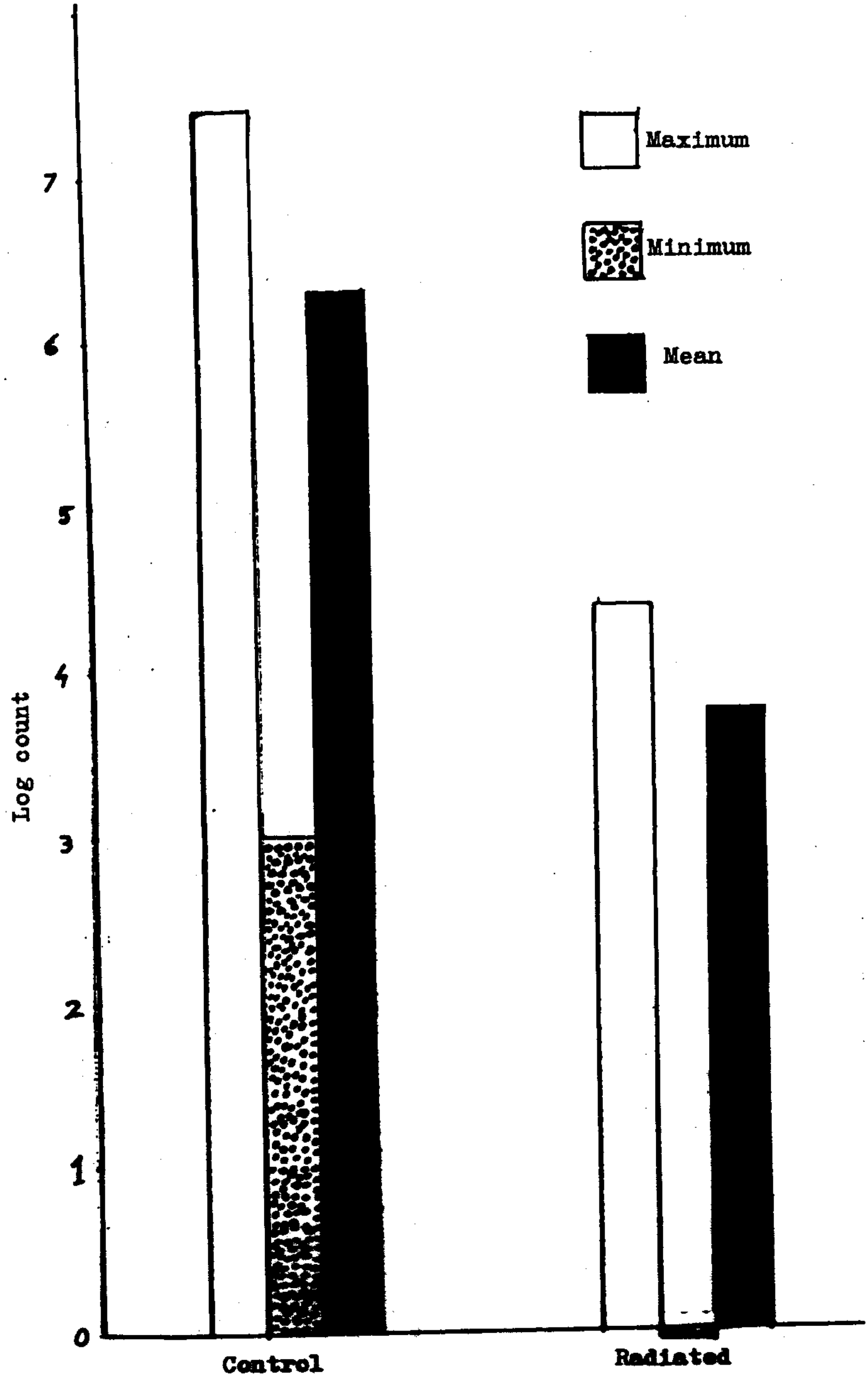

Fig.(9): The maximum, minimum and mean values for lactic acid bacteria in cows' milk.

bacteria in buffaloes' milk andit completely destroyed the low counts.

Table (24) show also that lactic acid bacterial counts per 1 ml (x 10^2) 157, 150, 100, 99, 130, 20 and 30 ml. in the control were completely destroyed by gamma radiation treatment. Also, the lactic acid bacterial counts (x 10^3) 70, 140, 97 and 37 ml. in the control were destroyed by the radiation treatment and rate of destruction was 100%. In other buffaloes' milk samples, the number of lactic acid bacteria, per 1 ml dropped from (x 10^3) 155, and 51 in the control to (x 10) 10 and 187/ ml. in irradiated milk. The percentages of destruction were 99.935 and 96.333%, respectively.

Lactic acid bacteria of the counts (x 10^4)70, 36, 55, 40, 97, 25, 103 and 75 in the control were reduced to (x 10^3) 18, 0.4, 15, 8, 37, 0.5, 7 and 5/ml., respectively, in the irradiated milk and the corresponding destruction percentages were 97.428, 99.888, 97.272, 98.0, 96.185, 99.80, 99.32 and 99.333%, respectively.

Table (24):- Effect of gamma radiation (250 Krad) on lactic acid producers bacteria in buffaloes' milk.

Samples No.	Control (Non-radiated)	Radiated	% of destruction
1	$155x10^3$	10x10	99.935
2	$70x10^3$	-	100
3	$157x10^2$	-	100
4	$140x10^3$	-	100
5	$97x10^3$	-	100
6	$70x10^4$	$18x10^3$	97.428
7	$37x10^3$	-	100
8	$36x10^4$	40x10	99.888
9	$55x10^4$	$15x10^3$	97.272
10	$100x10^5$	$40x10^3$	99.60
11	$40x10^4$	$80x10^2$	98.0
12	$97x10^4$	$37x10^3$	96.185
13	$25x10^4$	50x10	99.80
14	$103x10^4$	$70x10^2$	99.320
15	$150x10^2$	-	100
16	$75x10^4$	$50x10^2$	99.333
17	$100x10^2$	-	100
18	$90x10^2$	-	100
19	$51x10^3$	187x10	96.333
20	$130x10^2$	-	100
21	$20x10^2$	-	100
22	$30x10^2$	-	100

- = No growth.

Lactic acid bacteria of the counts 100×10^5 in the control was reduced to 40×10^3/ml. in the irradiated milk and the rate of destruction was 99.60%.

Table (25) and Figure (10) indicate that the maximum, minimum and mean values for lactic acid bacterial counts in buffaloes' milk were 100×10^5, 20×10^2 and 71×10^4 in the control; while in the irradiated milk were 40×10^3, 0.0 and 60×10^2/ml., respectively.

The maximum, minimum and mean rates of destruction were 100, 96.33 and 99.231%, respectively.

These results are inagreement with Dluzewski and Pijanowski (1964) who found that a dose of 144 Krad was needed to reduce the total bacterial count (mainly lactic acid bacteria) to 1.5%. Niewolak (1967) found that the dose 150-200 Krad was necessary to kill 99% of lactic acid bacteria. The results obtained in this study are also in accordance with Oberman and Makiedonska(1967) who observed that a dose of 0.35 Mrad was lethal to *Streptococcus lactis*.

Table (25):- The maximum, minimum and mean values for lactic acid producers bacteria in buffaloes' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$100x10^5$	$40x10^3$	100
Minimum	$20x10^2$	0.0	96.33
Mean	$71x10^4$	$60x10^2$	99.231

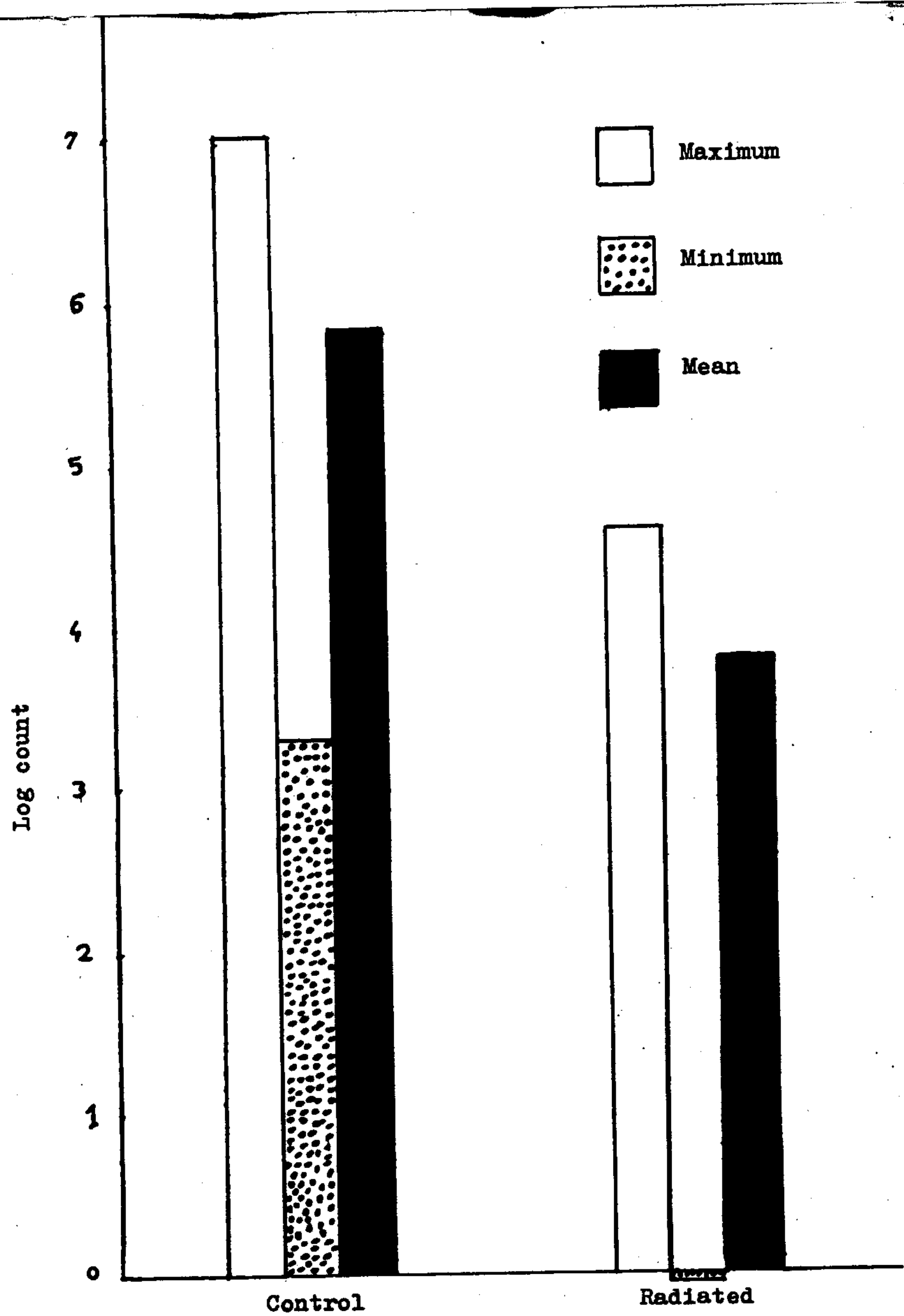

Fig. (10):- The maximum, minimum and mean values for lactic acid bacteria in buffaloes' milk.

13

4. Effect of gamma radiation on Lactobacilli:

The effect of gamma radiation (250 Krad) on Lactobacilli in cows' milk is given in Table (26). It shows that gamma irradiation completely destroyed low counts and it had a severe destructive effect on the high counts.

The lactobacilli counts (x 10^2) 10, 50, 25 and (x 10^3) 29, 30/ml in the control were completely destroyed and the percentages of destruction were 100%.

Lactobacilli counts (x 10^2) 72, and 80 in the control were reduced to 70 and 20 respectively, in irradiated milk and the percentages of destruction were 99.027 and 99.75%, while the lactobacilli counts (x 10^3)200, 220, 90, 53, 50 and 10 per 1 ml. in the control were reduced to (x 10) 6, 9, 50, 8, 12 and 34, ml. , respectively, in the irradiated milk. This corresponded to the following percentages of destruction 99.97, 99.959, 99.944, 99.849, 99.76 and 96.60%, respectively.

Table (26):- Effect of gamma radiation (250 Krad) on lactobacilli in cows' milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$200x10^3$	6x10	99.97
2	$67x10^4$	$170x10^2$	97.462
3	$72x10^2$	7x10	99.027
4	100x10	-	100
5	$65x10^5$	19x10	99.997
6	$220x10^3$	9x10	99.959
7	$90x10^3$	50	99.944
8	$55x10^4$	80x10	99.854
9	$29x10^3$	-	100
10	$53x10^3$	8x10	99.849
11	$30x10^3$	-	100
12	$50x10^3$	12x10	99.76
13	$37.5x10^5$	54x10	99.985
14	$80x10^2$	2x10	99.75
15	$50x10^2$	-	100
16	$10x10^3$	34x10	96.60
17	$45x10^4$	$95x10^2$	97.888
18	$25x10^2$	-	100
19	$212x10^4$	$13x10^2$	99.938
20	$70x10^4$	9x10	99.987
21	$200x10^5$	$192x10^2$	99.904

- = No growth.

Lactobacilli counts ($x\ 10^4$) 67, 55, 45, 212 and 70 in the control (Non-radiated cows' milk samples) were reduced to ($x\ 10^2$) 170, 8, 95, 13 and 0.9/ml. in irradiated milk. The percentages of destruction were 97.462, 99.854, 97.888, 99.938 and 99.987% respectively.

Lactobacilli counts dropped from ($x\ 10^5$)65, 37.5, and 200, respectively in the control to 190, 540 and 192 $x\ 10^2$/ml. after irradiation. The percentages of destruction were 99.997, 99.985 and 99.904%, respectively.

Table (27) and Figure (11) indicate that the maximum of lactobacilli count in cows' milk was 200 $x\ 10^5$,the minimum was 50 $x\ 10^2$ and the mean was 168.8 $x\ 10^4$ in the control, while in the radiated milk the maximum, minimum and mean were 192 $x\ 10^2$, 0.0 and 109 x 10/ml., respectively.

The maximum, minimum and mean percentages of destruction were 100, 96.60 and 99.52%, respectively.

Table (27):- The maximum, minimum and mean values for lactobacilli in cows' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$200x10^5$	$192x10^2$	100
minimum	$50x10^2$	0.0	96.60
Mean	$1688x10^3$	109x10	99.52

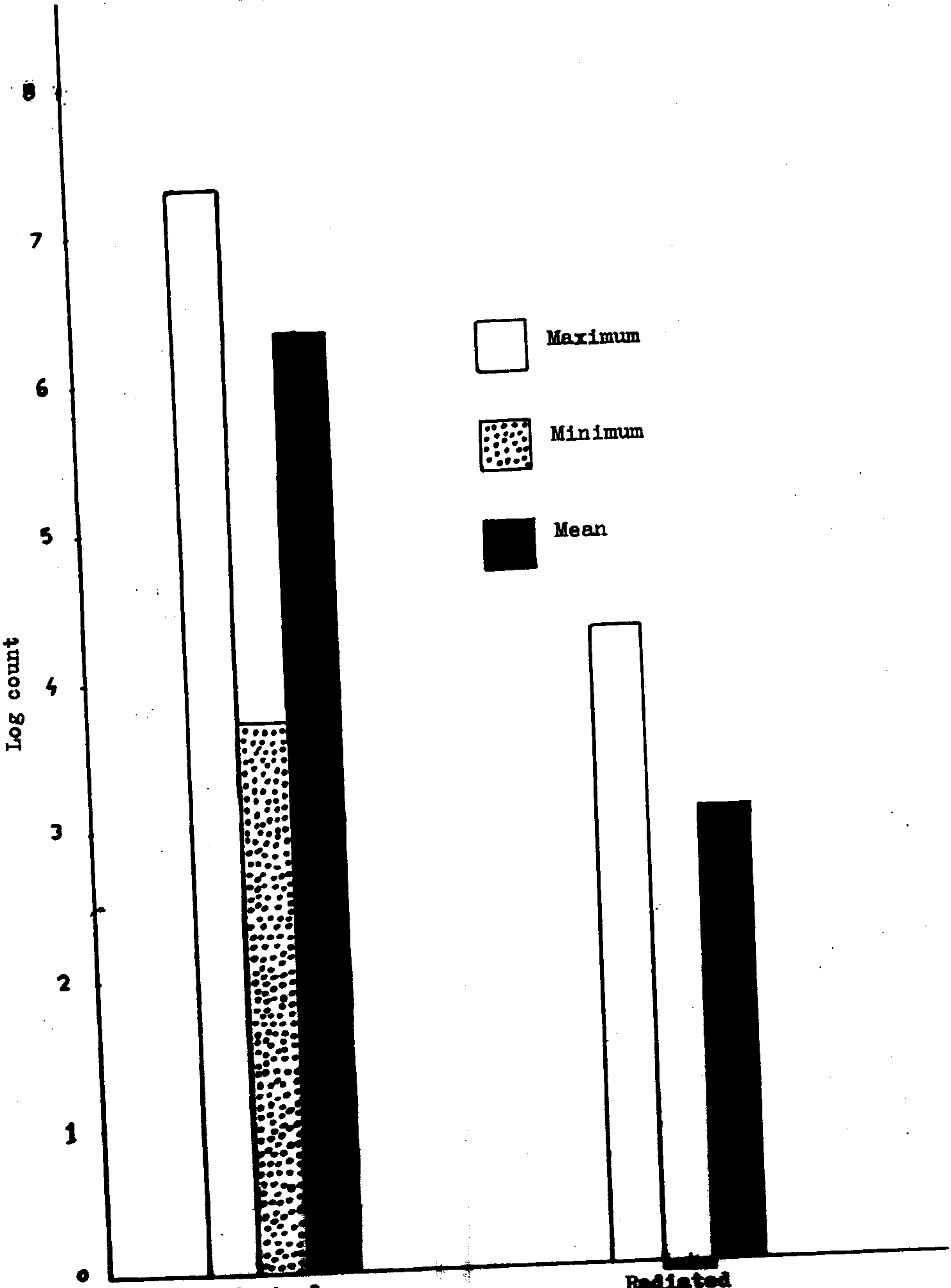

Fig. (11):- The maximum, minimum and mean values for lactobacilli in cows' milk.

Table (28) indicates the effect of gamma radiation (250 Krad) on Lactobacilli in buffaloes' milk. It shows that lactobacilli counts (x 10^2) 35, 40, 7, 210 and (31 x 10^3)/ml in the control were completely destroyed and the percentages of destruction were 100%.

The number per 1 ml dropped from (x 10^3) 120, 40, 51, 70, 35 and 130 respectively in the control to 10, 5, 5, 10, 6 and 30/ml., respectively in irradiated milk samples. The corresponding destruction rates were 99.916, 99.875, 99.901, 99.985, 99.828 and 99.769%, respectively.

The numbers of Lactobacilli per 1 ml were reduced from (x 10^4) 50, 70, 37, 70, 73, 79 and 13 in the control to (x 10^2) 120, 170, 5, 5, 1.7, 3 and 3/ml., respectively, in the irradiated milk. The percentages of destruction were 97.60, 97.571, 99.864, 99.928, 99.976,99.962 and 96.279%, respectively.

Table (28):- Effect of gamma radiation on lactobacilli in buffaloes' milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$50x10^4$	$120x10^2$	97.60
2	$70x10^4$	$170x10^2$	97.571
3	$37x10^4$	50x10	99.864
4	$120x10^3$	10x10	99.916
5	$40x10^3$	5x10	99.875
6	$35x10^2$	-	100
7	$40x10^2$	-	100
8	$70x10^4$	50x10	99.928
9	$51x10^3$	5x10	99.901
10	$73x10^4$	17x10	99.976
11	$71x10^5$	60x10	99.991
12	$7x10^2$	-	100
13	$56x10^5$	240x10	99.957
14	$31x10^3$	-	100
15	$70x10^3$	10	99.985
16	$35x10^3$	6x10	99.828
17	$79x10^4$	30x10	99.962
18	$210x10^2$	-	100
19	$43x10^4$	$160x10^2$	96.279
20	$130x10^3$	30x10	99.769

- = No growth.

Lactobacilli counts (x 10^5) 71 and 56 per 1 ml. in the control were reduced to (x 10) 60 and 240/ml., respectively, after irradiation. The corresponding destruction rates were 99.991 and 99.957%.

Table (29) and Figure (12) indicate that the maximum, of lactobacilli counts, minimum and mean, respectively were 71 x 10^5, 7 x 10^2 and 87 x 10^4 in the control while the maximum, minimum and mean of lactobacilli counts in irradiated milk, respectively were 170 x 10^2, 0.0 and 25 x 10^2/ml. The maximum, minimum and mean percentages of destruction were 100, 96.30 and 99.71%, respectively. These results are inagreement with Niven (1958), who found that the gamma radiation doses 200-300 Krad reduced Lactobacillus (hetero F.) a million-fold and 500-700 Krad reduced Lactobacillus (homo F.) a million-fold.

Table (29):- The maximum, minimum and mean values for lactobacilli in buffaloes' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	71×10^5	170×10^2	100
Minimum	7×10^2	0.0	96.30
Mean	87×10^4	25×10^2	99.71

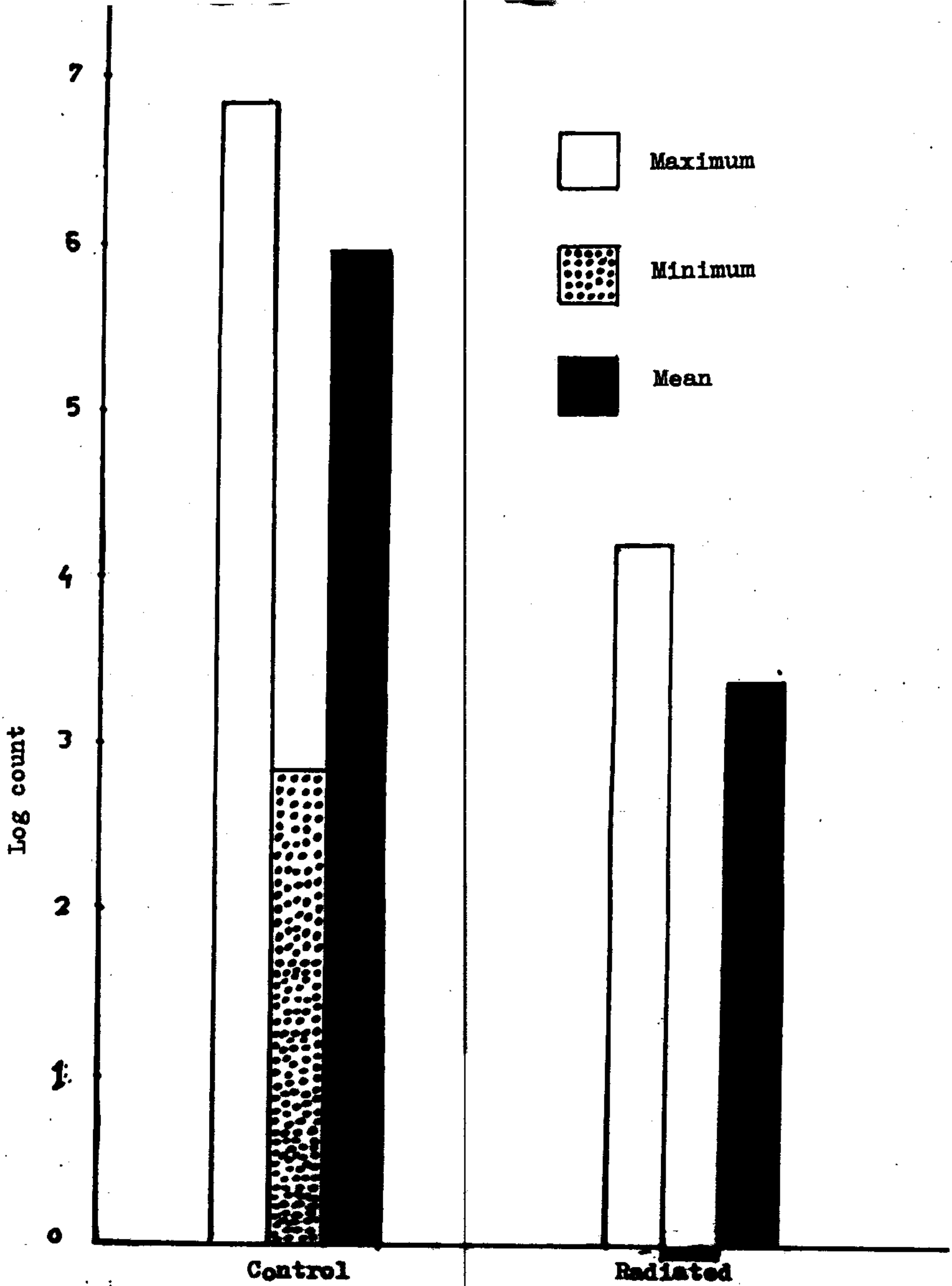

Fig.(12):- The maximum, minimum and mean values for lactobacilli in buffaloes' milk.

5. Effect of gamma radiation (250 Krad) on yeasts and moulds:

Data concerning the effect of gamma radiation (250 Krad) on yeasts and moulds counts in cows' milk are reported in Table (30). These data shows that the gamma radiation treatment completely destroyed the yeasts and moulds in more than 50% of the irradiated samples.

In the remaining samples, the number of yeasts and mould per 1 ml dropped from 900 and 800, in the control to 20 and 10 in irradiated milk.

The counts per 1 ml dropped from (x 10^2) 11,13, 19, 37, 40, 70, 130 and 160/ml. in the control to 40, 45, 50, 10, 20, 40, 30 and 40/ml., respectively in irradiated milk. This corresponded to the percentages of destruction of 96.363, 96.538, 96.315, 99.729, 99.50, 99.428, 99.769 and 99.75%, respectively.

Table (31) and Figure (13) indicate that the maximum, minimum and mean of yeasts and moulds in cows' milk

Table (30):- Effect of gamma radiation (250 Krad) on yeasts and moulds in cows' milk.

Samples No.	Control (Non-radiated)	Radiated	% of destruction
1	85x10	-	100
2	73x10	-	100
3	30x10	-	100
4	72x10	-	100
5	90x10	20	97.777
6	80x10	10	98.75
7	34x10	-	100
8	14x10	-	100
9	$11x10^2$	40	96.363
10	$13x10^2$	45	96.538
11	$19x10^2$	50	96.315
12	7x10	-	100
13	$70x10^2$	-	100
14	$37x10^2$	10	99.729
15	7x10	-	100
16	$11x10^2$	-	100
17	$40x10^2$	20	99.50
18	$70x10^2$	40	99.428
19	$130x10^2$	30	99.769
20	$160x10^2$	40	99.75
21	$7x10^2$	-	100

- = No growth.

Table (31):- The maximum, minimum and mean values for yeasts and moulds in cows' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$160x10^2$	50	100
Minimum	7x10	0.0	96.315
Mean	$29x10^2$	14	99.234

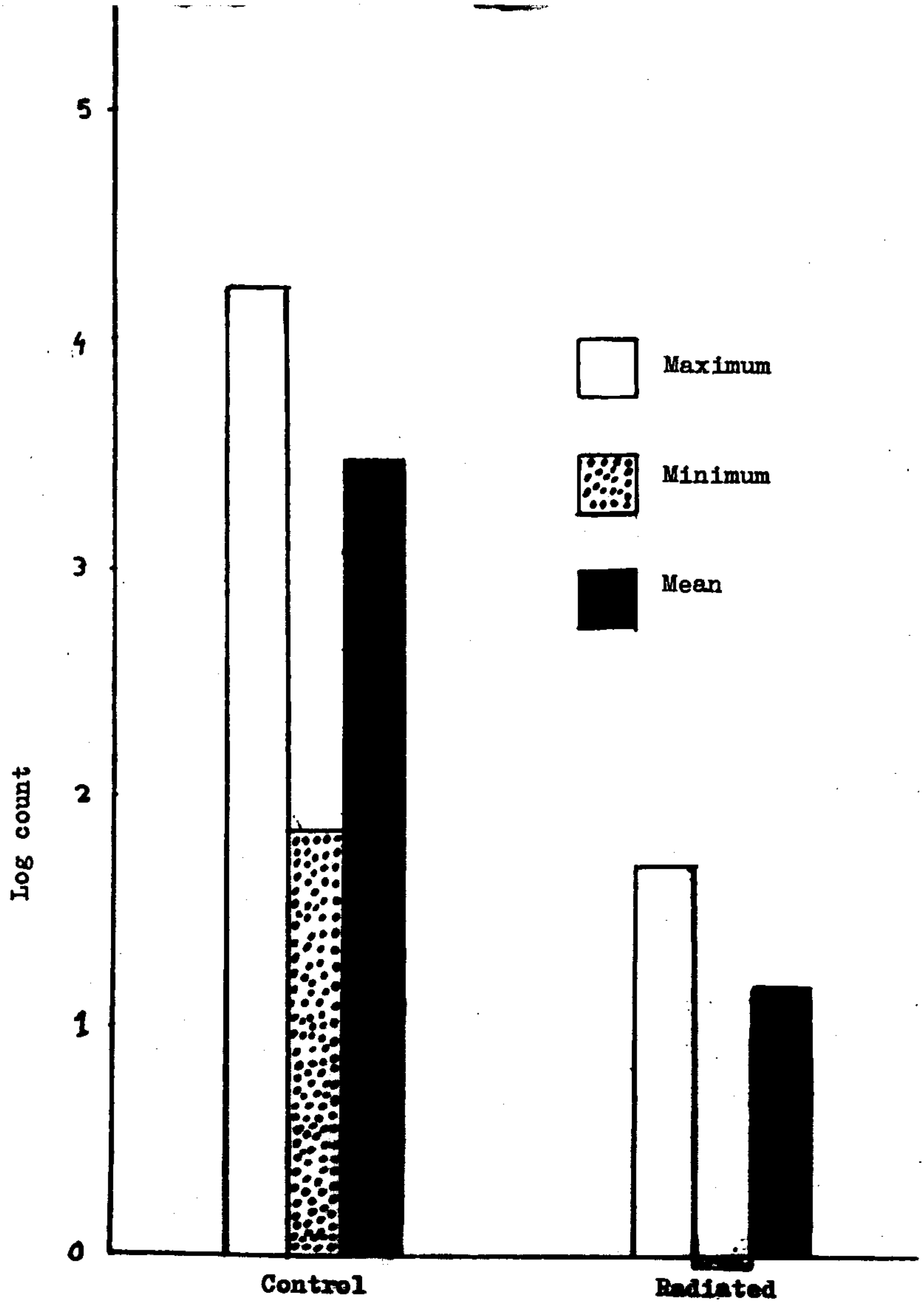

Fig.(13):- The maximum, minimum and mean values for moulds and yeasts in cows' milk.

(control) were 160 x 10^2, 7 x 10 and 29 x 10^2 were reduced to 50, 0.0 and 14/ml., respectively by irradiation. The maximum, minimum, and mean rates of destruction were 100, 96.315 and 99.234%, respectively.

Table (32)shows that yeasts and moulds were completely destroyed in 60% of buffaloes' milk samples by exposure to gamma radiation (250 Krad). In some buffaloes' milk samples, yeasts and moulds counts (x 10) 87, 95 and 87 in the control were reduced to 30, 10 and 10/ml., respectively in irradiated milk. In other milk samples,the yeasts and moulds counts (x 10^2), 22, and 62 in the control were reduced to 10 and 10 ml. in irradiated milk. This corresponded to destruction rates of 99.545 and 99.838%, respectively. The number of yeasts and moulds per 1 ml. in the remaining samples dropped from (x 10^3) 23, 21 and 40, respectively in control (Non-radiated buffaloes' milk) samples) to 30, 20 and 40/ml. in irradiated milk. The rates of destruction were 99.986, 99.904 and 99.90%, respectively.

Table (33) and Figure (14) indicate that the

Table (32):- Effect of gamma radiation (250 Krad) on yeasts and moulds in buffaloes' milk.

Samples No.	Control (Non-radiated)	Radiated	% of destruction
1	42x10	-	100
2	35x10	-	100
3	41x10	-	100
4	9x10	-	100
5	$37x10^2$	-	100
6	17x10"	-	100
7	15x10	-	100
8	87x10	30	96.551
9	$22x10^2$	10	99.545
10	95x10	10	98.947
11	87x10	10	98.850
12	$50x10^2$	-	100
13	$16x10^2$	-	100
14	37x10	-	100
15	$23x10^3$	30	99.986
16	$21x10^3$	20	99.904
17	$40x10^3$	40	99.90
18	$62x10^2$	10	99.838
19	9x10	-	100
20	19x10	-	100

- = No growth.

Table (33):- The maximum, minimum and mean values for yeasts and moulds buffaloes' milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$40x10^3$	30	100
Minimum	9x10	0.0	96.551
Mean	$54x10^2$	8	99:68

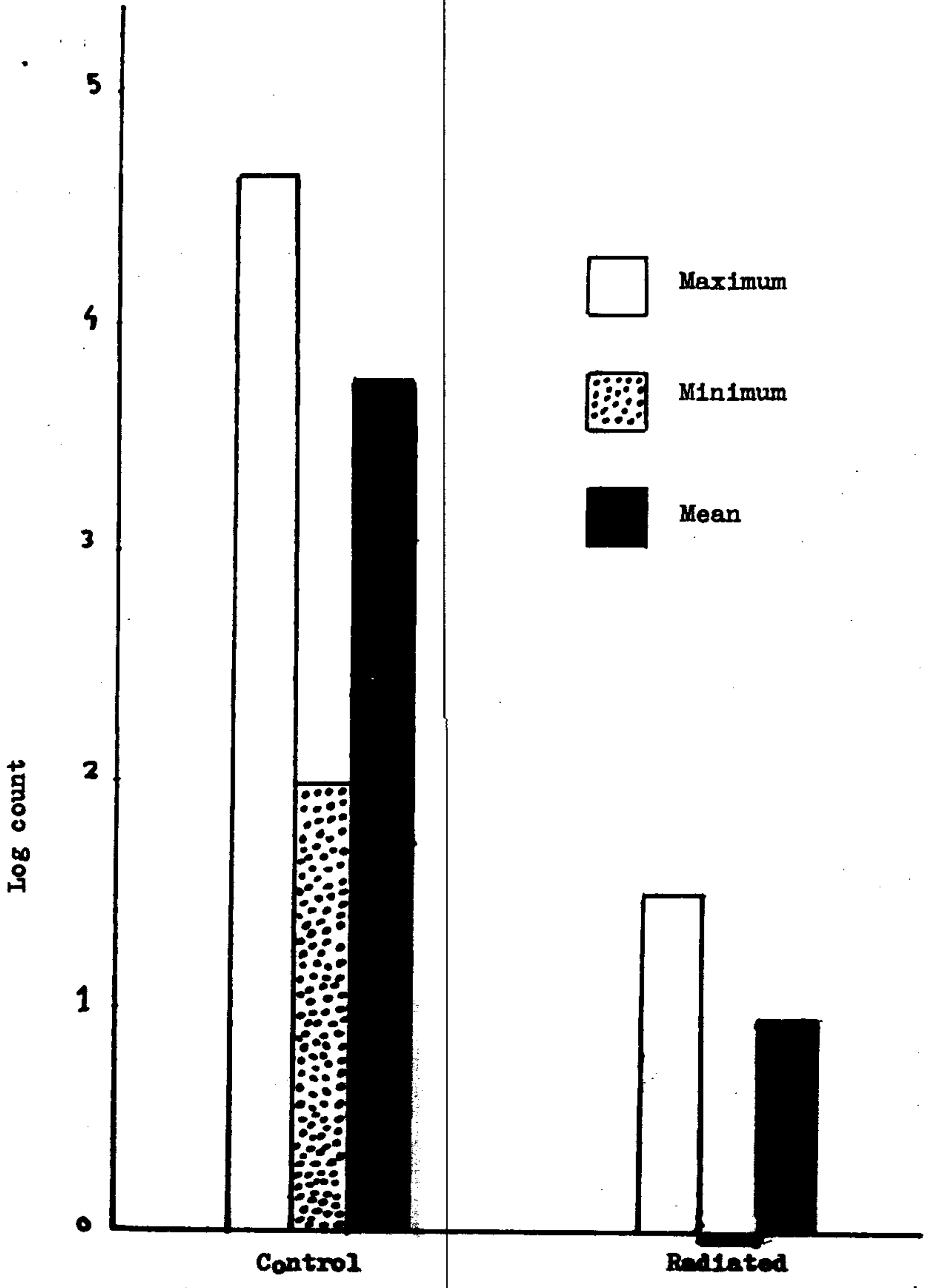

Fig.(14):- The maximum, minimum and mean values for moulds and yeasts in buffaloes' milk.

maximum values for yeasts and moulds counts, minimum and mean in the control were 40×10^3, 9×10 and 54×10^2, respectively; while in irradiated milk they were 30, 0.0 and 8/ml., respectively. The maximum, minimum and mean rates of destruction were 100, 96.551 and 99.68%, respectively.

These results are not inagreement with Naghmoush et al., (1983) who observed that yeasts and moulds were completely destroyed with all selected doses (0.25, 0.50 and 0.75 Mrad). This simply can be deduced to the low count of yeasts and moulds which ranged from 310 to 570/ml.

6. <u>Effect of gamma radiation (250 Krad) on Spore-formers</u>:

Spore-formers were estimated in 5 samples of raw milk by heating them to 80°C for 15 minutes. The samples were exposed to gamma radiation at 250 Krad.

Table (34) indicates that the spore-formers were reduced in one sample from 125 x 10^3 in the control to 33 x 10^2/ml. in irradiated milk. The rate of destruction was 97.360%.

The spore-formers per 1 ml were reduced in other samples from (x 10^4) 51, 125, 71 and 13, respectively in the control to (x 10^2) 36, 32, 31 and 11/ml., respectively, in irradiated milk. This corresponded to the following destruction rates 99.294, 97.44, 99.563 and 99.153%, respectively.

Table (35) and Figure (15) show that the maximum spore-formers counts, minimum and mean in the control were (x 10^4) 125, 13 and 55, respectively; while in irradiated milk they were (x 10^2) 320, 11 and 86/ml., Table (34):- Effect of gamma radiation (250 Krad) on spore-formers in raw milk.

Samples No.	Control (Non-radiated)	Radiated	%of destruction
1	$51x10^4$	$36x10^2$	99.294
2	$125x10^4$	$32x10^2$	97.440
3	$125x10^3$	$33x10^2$	97.360
4	$71x10^4$	$31x10^2$	99.563
5	$13x10^4$	110x10	99.153

Table (35):- The maximum, minimum and mean values for spore-formers in raw milk.

Bacterial content	Control (Non-radiated)	Radiated	%of destruction
Maximum	$125x10^4$	$32x10^3$	99.563
Minimum	$130x10^3$	110x10	97.36
Mean	$55x10^4$	$86x10^2$	98.56

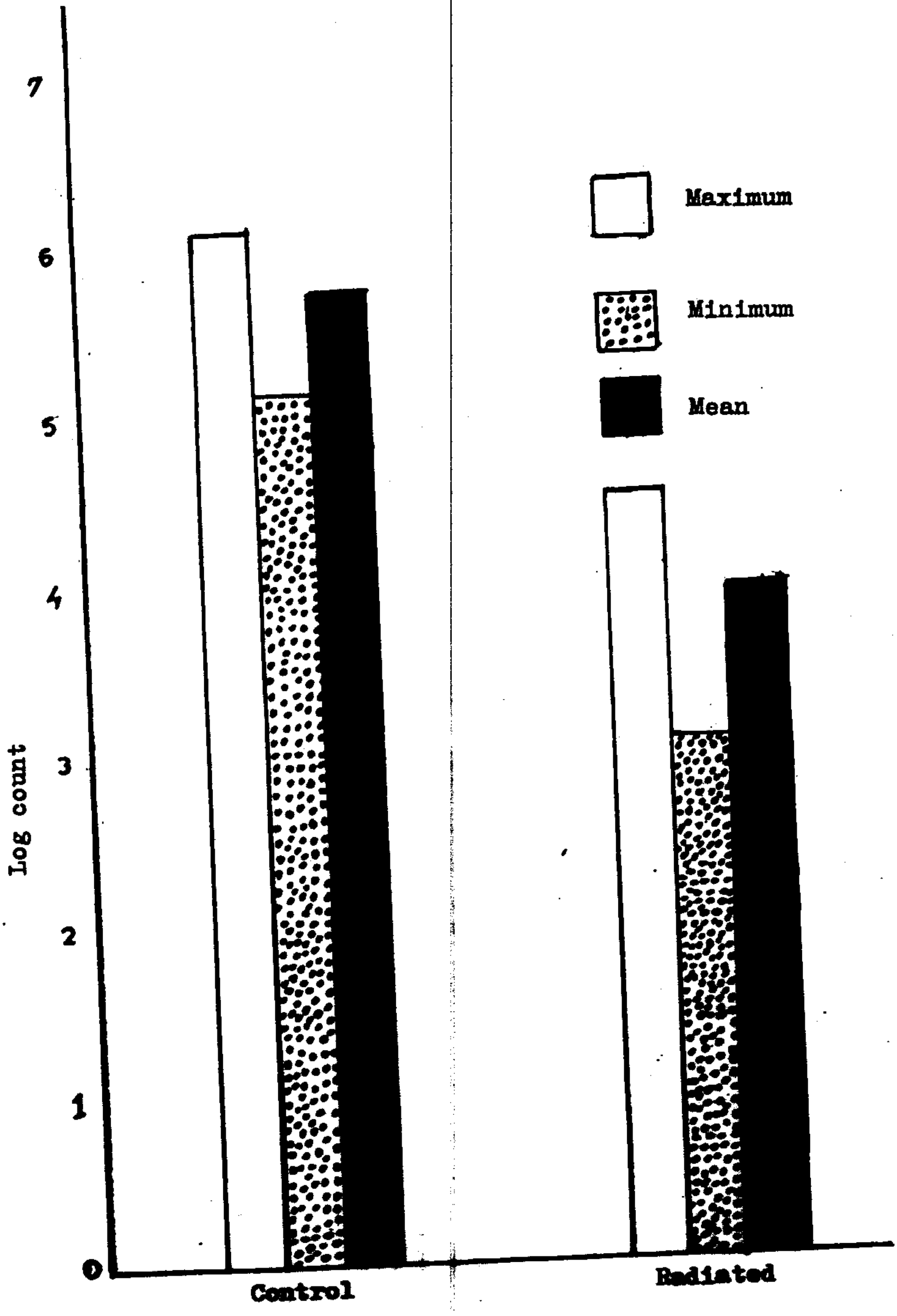

Fig.(15):- The maximum, minimum and mean values for Sporformers in milk.

respectively. The maximum, minimum and mean rates of destruction were 99.563, 97.36 and 98.56%, respectively.

These results are inagreement with Anellis et al., (1959) who observed that B. coagulans spores were resistance to gamma radiation. The results are also in agreement with Niewolak (1967) who observed that spore-formers were more resistant to radiation than other bacteria.

PART (2)

"EFFECT OF MILK TEMPERATURES DURING IRRADIATION ON TOTAL BACTERIAL COUNT AND KEEPING QUALITY"

EXPERIMENTAL

Each sample of cows' and buffaloes' milk was divided into four parts. The first was left unirradiated (raw) at 30°C and used as a control. The second sample was cooled at 10°C and left unirradiated (raw) and used as a control. The third and fourth portions were adjusted at 30°C and 10°C respectively each was divided into 3 fractions and all were exposed to different doses of gamma radiation at 100, 200 and 300 Krad.

Samples were irradiated in test tubes (1.5 x 17 cm). The fourth portion samples were placed in a liter beaker containing ice to keep the temperature at 10°C.

All four samples were analyzed; daily for the total bacterial count; keeping quality at room temperature and at refrigerator temperature for 15 days.

Effect of Milk Samples Temperatures During Radiation on Total Bacterial Count in Cows' Milk:

Data in Table (36) revealed that the total bacterial count per 1 ml in sample No. 1 at 10°C was reduced from 37 x 10^4 in the control to 630, 400 and 230/ml., at 100, 200 and 300 Krad, respectively. This corresponded to percentages of destruction 99.829, 99.891 and 99.937% respectively. While at 30°C, the total count was reduced from 54 x 10^4 in the control to (x 10) 115, 85 and 57 /ml. at 100, 200 and 300 Krad, respectively. The corresponding destruction rates were 99.787, 99.842 and 99.894% respectively.

The total count in sample No.2 at 10°C was reduced from 125 x 10^3 in the control to 16 x 10^2, 20 and 20 /ml., at the doses 100, 200 and 300 Krad, respectively. This corresponded to the percentages of destruction 98.72, 99.84% and 99.98%, respectively. While at 30°C the total bacterial count was reduced from 235 x 10^3 in the control to 55 x 10^2, 13 x 10^2 and 50/ml., respectively at doses 100, 200 and 300 Krad. The corresponding destruction rates were 97.659 , 99.446 and 99.978%, Table (36):- Effect of milk samples temperatures during radiation on total bacterial count in cows' milk.

Dose Krad	Sample No.	Radiated at 10°C			Radiated at 30°C		
		Control (Non-radiated)	Radiated	%of destruction	Control (Non-radiated)	Radiated	%of destruction
100	1	$37x10^4$	63x10	99.829	$54x10^4$	115x10	99.787
	2	$125x10^3$	$16x10^2$	98.72	$235x10^3$	$55x10^2$	97.659
Mean		$247.5x10^3$	111.5x10	99.274	$38.75x10^4$	$33.25x10^2$	98.723
200	1	$37x10^4$	40x10	99.891	$54x10^4$	85x10	99.842
	2	$125x10^3$	2x10	99.84	$235x10^3$	$13x10^2$	99.446
Mean		$247.5x10^3$	21x10	99.865	$38.75x10^4$	107.5x10	99.644
300	1	$37x10^4$	23x10	99.937	$54x10^4$	57x10	99.894
	2	$125x10^3$	2x10	99.98	$235x10^3$	50	99.978
Mean		$247.5x10^3$	12.5x10	99.958	$38.75x10^4$	31x10	99.936

<u>Effect of Milk Samples Temperatures During Radiation on Total Bacterial Count in Buffaloes' Milk</u>:

Results in Table (37) show that the total bacterial count in sample No. 1, at 10°C, was reduced from 82 x 10^3 in the control to 400, 60 and 20/ml. at 100, 200 and 300 Krad, respectively. This corresponded to the destruction rates 99.512, 99.926 and 99.975%, respectively. While at 30°C the total count was reduced from 120 x 10^3 in the control to (x 10) 20, 100 and 10/ml. at 100, 200 and 300 Krad, respectively. The corresponding destruction rates were 99.833, 99.166 and 99.916%, respectively.

The total bacterial counts per 1 ml in sample No. 2 at 10°C was reduced from 42 x 10^5 in the control to 95 x 10^3, 250 x 10^2 and 152 x 10^2/ml. in irradiated milk at doses 100, 200 and 300 Krad, respectively. The corresponding destruction rates were 97.738, 99.404 and 99.638%,respectively. When the irradiation was at 30°C the total bacterial count was reduced from 95 x 10^5 in the control to (x 10^2) 250, 170 and 95/ml., Table (37):- Effect of milk samples temperatures during radiations on total bacterial count in buffaloes' milk.

Dose Krad	Sample No.	Radiated at 10°C			Radiated at 30°C		
		Control (Non-radiated)	Radiated	%of destruction	Control (Non-radiated)	Radiated	%of destruction
100	1	$82x10^3$	40x10	99.512	$120x10^3$	20x10	99.833
	2	$42x10^5$	$95x10^3$	97.738	$95x10^5$	$25x10^3$	97.271
	3	$45x10^4$	$65x10^2$	98.555	$60x10^4$	$100x10^2$	98.333
	Mean	$157.733x10^4$	$33.966x10^3$	98.601	$33.066x10^5$	$117.333x10^2$	98.479
200	1	$82x10^3$	60	99.926	$120x10^3$	100x10	99.166
	2	$42x10^5$	$250x10^2$	99.404	$92x10^5$	$170x10^2$	99.815
	3	$45x10^4$	105x10	99.766	$60x10^4$	250x10	99.583
	Mean	$157.733x10^4$	$87.033x10^2$	99.689	$33.066x10^5$	$68.33x10^2$	99.520
300	1	$82x10^2$	20	99.975	$120x10^3$	100	99.916
	2	$42x10^5$	$152x10^2$	99.638	$92x10^5$	$95x10^2$	99.989
	3	$45x10^4$	40x10	99.911	$60x10^4$	117x10	99.805
	Mean	$157.733x10^3$	$52.066x10^2$	99.841	$33.066x10^5$	$35.9x10^2$	99.903

respectively, in irradiated milk at doses 100, 200 and 300 Krad; the destruction rates were 97.271, 99.815 and 99.989%, respectively. The total bacterial count in sample No. 3 per 1 ml at 10°C was reduced from 45 x 10^4 in the control to (x 10^2)65, 10.5 and 4/ml., respectively in irradiated milk at doses 100, 200 and 300 Krad. The destruction rates were 98.555, 99.766 and 99.911%, respectively. While at 30°C, the counts were reduced from 60 x 10^4 in the control to (x 10^2), 100, 25 and 11.7/ml., respectively in irradiated milk at the same doses. The destruction rates were 98.33, 99.583 and 99.805%, respectively.

The total bacterial count in buffaloes' milk showed more reduction at the lower temperature of irradiation (10°C) than at the higher one (30°C). Data also show that the higher the dose of radiation the greater reduction in total count of buffaloes' milk. The rate of microbial destruction increased as the dose of radiation was increased. These results are generally inagreement with Brynjolfsson (19).

The results concerning the effect of temperature of irradiated milk on microbial counts showed slight differences when the irradiation was at 30°C or at 10°C. This may be due to that both the direct effect (effect of radiation on the DNA of the microbial cells) and the indirect effect (effect of radiation on water and producing free radicals harmful to microbial cells), were effective on 10°C and 30°C. Only at freezing temperatures, the effect of radiation will be due to the direct effect only and the indirect effect will be abolished due to the change of water to ice.

Effect of Gamma Radiation on the Keeping Quality of Milk:

1. Effect of radiation on the keeping quality of cow's milk:

Data concerning the effect of different doses of gamma radiation on the keeping quality of cows' milk are indicated in Tables (38) and (39). Data show that refrigeration increased the keeping quality of milk from 1 days to four days, as indicated by the clot-on-boiling test. Cooling prevents some microorganisms from growth and decreases the biological activities of the others, thus cooling prolongs the keeping quality of milk.

The irradiation of cows' milk at 30°C did not increase the keeping quality of milk stored at room temperature after irradiation. The keeping quality for all radiation treatments(100, 200 and 300 Krad)of cows' milk at 30°C was identical with that of control (1 days), when stored at room temperature. However, the irradiation of cows' milk at 10°C then storage at room temperature, slightly increased the keeping quality to be 1, 2 and 2 days at 100, 200 and 300 Krad as compared to control which was 1 day.

Table (38):- Effect of different doses of gamma radiation on clot-on-boiling of cows' milk.

Dose Krad	Sto-rage temp.	Sam-ples No.	Keeping Quality of Cows milk																													
			Irradiated at 10°C (Days)															I rradiated at 30°C (Days)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cont-rol	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
		3	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
100	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
200	Room temp.	1	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	Room temp.	1	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

+ = Coagulated - = Not coagulate

Table (39):- Effect of different doses of gamma radiation on keeping quality of cows' milk.

Treatment	Storage temp.	Keeping Quality in days	
		Irradiated at 10°C	Irradiated at 30°C
Control	Room temp.	<1	<1
	Ref. temp.	4	4
100	Room temp.	1	1
	Ref. temp.	11	9
200	Room temp.	2	1
	Ref. temp.	14	13
300	Room temp.	2	1
	Ref. temp.	15	15

On the other hand, irradiation of milk at 10°C then refrigeration (7 ± 1°C) increased the keeping quality of milk for 11, 14 and 15 days for the doses 100, 200 and 300 Krad, respectively, while the keeping quality of control was 4 days. While irradiation of cows' milk at 30°C then storage at refrigeration increased the keeping quality of irradiated milk in the refrigerator for 9, 13 and 15 days for the doses 100, 200 and 300 Krad, respectively, (control was 4 days). It seems that irradiation at 10°C was more effective than that at 30°C, in increasing the keeping quality of cows' milk.

Results in Table (38) and (39) also show that irradiation (with the used doses) increased the keeping quality of milk in the refrigerator. The effect increased with increasing the radiation dose.

2. Effect of radiation on the keeping quality of buffaloes' milk:

Tables (40)and(41), indicate the effect of gamma radiation on buffaloes' milk. Results show that refrigeration (7 ± 1°C) increased the keeping quality of unradiated buffaloes' milk to be 4 days while the control (at room temperature) was 1 day. Data also show that, gamma radiation treatments of buffaloes' milk (100, 200 and 300 Krad) either at 10°C or at 30°C then storage at room temperature, did not increase the keeping quality which was 1 day for all treatments than the control.

It was also observed that, as in the case of cows' milk, the irradiation of buffaloes' milk increased its keeping quality in the refrigerator.

From Tables (38, 39, 40 and 41) the following conclusions were obtained:

1. Refrigeration increased the keeping quality of cows' and buffaloes' milk to 4 days as compared to the keeping quality of unrefrigerated milk (1 day).

Table (40):- Effect of different doses of gamma radiation on clot-on-boiling buffaloes' milk.

Dose Krad	Storage temp.	Samples No.	Keeping Quality of buffaloes' milk																													
			Irradiated at 10°C (Days)															Irradiated at 30°C (Days)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Control	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+
100	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. temp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	Room temp.	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ref. remp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

+ = Coagulated.   - = Not coagulate.

Table (41):- Effect of different doses of gamma radiation on keeping quality of buffaloes' milk.

Treatment	Storage temp.	Keeping Quality in days	
		Irradiated at 10°C	Irradiated at 30°C
Control	Room temp.	< 1	< 1
	Ref. temp.	4	4
100	Room temp.	1	1
	Ref. temp.	14	13
200	Room temp.	1	1
	Ref. temp.	15	14
300	Room temp.	1	1
	Ref. temp.	15	15

2. The irradiation at 10°C was more effective than irradiation at 30°C, in increasing the keeping quality of the irradiated milk, when stored at refrigerator after irradiation. This is inagreement with Frazier;(1967) who reported that low irradiation doses than that needed to sterilize foods can be used in combination with other preservation methods such as refrigeration, heating, drying and addition of chemicals, to extent the storage life of foods.

PART (3)

ORGANOLEPTIC EVALUATION OF COW'S AND BUFFALOE'S MILK AS AFFECTED BY DIFFERENT DOSES OF GAMMA RADIATION

EXPERIMENTAL

Samples of fresh cows' and buffaloes' milk were irradiated at doses 100, 200 and 300 Krad.

Samples were also examined organoleptically for the flavour and also Judged for variations in colour by a group of panelists of the staff members of the Dairy Research Laboratory, National Research Center.

Organoleptic evaluation were determined in the control and in the irradiated samples directly after irradiation, 7 days and 15 days after irradiation.

<u>Organoleptic Evaluation of Cows' and Buffaloes' Milk Before and After Irradiation at Different Doses of Gamma Radiation and During Storage</u>:

The effect of gamma radiation on the physical and chemical properties of cows' and buffaloes' milk is reflected on the organoleptic properties as shown in Tables (42-45).

Data in Tables (42 and 43) indicate that irradiation caused alterations in cows' milk particularly in the flavour with detectable changes in colour which turned it to whitish in all investigated samples.

The flavour of irradiated milk was changed to slightly oxidized táste. After storage of irradiated milk at the refrigerator temperature (7 ± 1°C) for 15 days the flavour improved than that stored for 7 days. This means that the deterioration in the organoleptic characteristics of milk due to irradiation is diminished during storage.

Results in Table (43) show that the mean average of scores of 3 samples of cows' milk in the control(before

Table (42):- Organoleptic evaluation of cows milk initially and after 7 and 15 days of gamma irradiation at different doses.

Dose Krad	Samples No.	Test time	Odor (30)	Appearance (20)	Taste (50)	Total (100)
	1	Control (Non-radiated milk)	29.5	19.5	42.5	91.5
	2		25.5	18.5	40.5	84.5
	3		28.0	18.5	45.0	91.5
Mean			27.66	18.83	42.66	89.16
100	1	Directly after radiation	24.0	16.0	33.5	72.5
	2		23.0	17.5	35.0	75.5
	3		16.0	15.5	25.0	56.5
Mean			21.0	16.33	31.16	68.16
200	1	Directly after radiation	20.0	10.0	30.0	60.0
	2		21.0	16.5	29.5	67.0
	3		14.5	15.0	24.0	53.5
Mean			18.5	13.83	27.83	60.16
300	1	Directly after radiation	16.5	10.0	22.5	49.0
	2		18.5	12.0	25.0	55.5
	3		11.0	15.0	19.5	45.5
Mean			15.33	12.33	22.33	50.0
100	1	7 days after radiation	21.5	11.5	29.0	62.0
	2		19.5	13.0	25.0	57.5
	3		19.5	15.5	33.5	68.5
Mean			20.16	13.33	29.16	62.7
200	1	7 days after radiation	15.0	9.0	27.0	51.0
	2		13.5	11.5	20.0	45.0
	3		17.5	13.5	30.0	61.0
Mean			15.33	11.33	25.7	52.33
300	1	7 days after radiation	22.5	9.0	19.0	40.5
	2		11.5	11.0	17.5	40.0
	3		15.0	12.0	27.5	54.5
Mean			16.33	10.66	21.33	45.00

Table (42):- Cont's.

Dose Krad	Samples No.	Test time	Odor (30)	Appearance (20)	Taste (50)	Total (100)
100	1	15 days after radiation	19.0	15.5	27.5	62.0
	2		20.0	17.5	28.0	65.5
	3		22.5	16.5	35.0	78.0
Mean			20.5	16.5	30.16	67.83
200	1	15 days after radiation	16.5	13.5	24.0	45.0
	2		19.5	17.5	25.0	62.0
	3		19.5	15.0	30.0	61.5
Mean			18.5	15.33	26.33	56.16
300	1	15 days after radiation	16.0	11.0	22.5	49.5
	2		14.5	17.0	23.5	55.0
	3		17.5	14.5	26.0	58.0
Mean			16.0	14.16	24.0	54.16

Table (43):- Summary of organoleptic evaluation of cow's milk initially and after 7 and 15 day of gamma irradiation at different doses.

Treatment	Mean of scores directly after treatment	Mean of scores after 7 days	Mean of scores after 15 days
Control	89.16	Clotted	Clotted
100 Krad	68.16	62.70	67.83
200 Krad	60.16	52.33	56.16
300 Krad	50.00	45.00	54.16

irradiation) was 89.16 points. Directly after irradiation the meams of scores were 68.16, 60.16 and 50 points at 100, 200 and 300 Krad, respectively. After 7 days storage at the refrigerator temperature, the means of scores were 62.7, 52.33 and 45 points, at 100, 200 and 300 Krad, respectively. After 15 days storége, the means of scores were 67.83, 56.16 and 54.16 points at doses 100, 200 and 300 Krad, respectively. The aforementioned results indicate that the deterioration in the organoleptic characteristics of cows' milk occurred directly after irradiation and continued for 7 days. Thereafter, there was partial improvement in the organoleptic characteristics which could be detected after 15 days from irradiation.

These results are inagreement with Odegov and Ostrumov (1976) who observed that the colour of milk was changed at a dose of 0.103 Mrad and the change in colour increased with increasing the radiation dose.

Data concerning the organoleptic evaluation of irradiated buffaloes' milk are recorded in Tables (44)and (45). Three samples of buffaloes' milk were irradiated at doses 100, 200 and 300 Krad. The changes occurred mainly in the flavour.

Table (44):- Organoleptic evaluation of buffaloes' milk initially and after 7 and 15 days of gamma irradiation at different doses.

Dose Krad	Samples No.	Test time	Odor (30)	Appearance (20)	Taste (50)	Total (100)
	1	Control (Non-radiated milk)	27.5	19.0	45.0	91.5
	2		24.5	18.5	41.0	84.0
	3		26.0	19.0	46.5	91.5
Mean			26.0	18.83	44.16	89.0
100	1	Directly after radiation	15.0	18.0	25.0	58.0
	2		20.0	18.0	31.5	69.5
	3		22.0	17.0	33.5	72.5
Mean			19.0	17.66	30.00	66.66
200	1	Directly after radiation	12.5	18.0	20.0	50.5
	2		18.0	18.5	29.0	65.5
	3		19.0	17.0	30.0	66.0
Mean			16.5	17.83	26.33	60.66
300	1	Directly after radiation	9.5	18.5	17.0	45.0
	2		15.0	18.5	25.0	58.5
	3		16.5	17.0	27.5	61.0
Mean			13.66	18.0	23.16	54.83
100	1	7 days after radiation	14.5	16.0	24.0	54.5
	2		20.0	16.5	29.5	66.0
	3		24.5	16.5	26.5	67.5
Mean			19.66	16.33	26.66	62.66
200	1	7 days after radiation	12.0	16.0	21.0	49.0
	2		15.0	17.5	26.0	58.5
	3		19.5	17.5	24.5	59.5
Mean			15.5	17.0	23.83	55.66
100	1	7 days after radiation	10.0	15.5	16.5	42.0
	2		13.5	17.5	25.0	56.0
	3		15.5	16.0	19.0	50.5
Mean			13.0	16.33	20.16	49.5

Table (44):- Cont's.

Dose Krad	Samples No.	Test time	Odor (30)	Appearance (20)	Taste (50)	Total (100)
	1	15 days after	13.0	15.0	24.0	54.5
100	2	radiation	14.5	17.5	36.0	74.5
	3		25.0	17.5	35.5	78.0
Mean			20.16	16.66	31.83	69.0
	1	15 days after	11.0	12.0	20.5	43.0
200	2	radiation	20.5	17.5	30.5	70.0
	3		23.0	17.0	32.5	72.5
Mean			18.16	15.5	27.83	61.8
	1	15 days after	10.0	10.0	20.0	40.0
300	2	radiation	18.0	17.0	28.5	63.5
	3		21.5	17.0	30.0	68.5
Mean			16.5	14.66	26.16	57.33

Table (45):- Summary of organoleptic evaluation of buffaloes' milk initially and after 7 and 15 days of gamma irradiation at different doses.

Treatment	Mean of scores directly after treatment	Mean of scores after 7 days	Mean of scores after 15 days
Control	89.16	Clotted	Clotted
100 Krad	68.16	62.70	67.83
200 Krad	60.16	52.33	56.16
300 Krad	50.00	45.00	54.16

The mean average of scores in the control of buffaloes' milk was 89 points, directly after irradiation the means of scores were 66.66, 60.66 and 54.85 points at doses 100, 200 and 300 Krad, respectively.

The means of scores of irradiated buffaloes' milk after storage at refrigerator temperature for 7 days were 62.66, 55.66 and 49.50 points at 100, 200 and 300 Krad, respectively. After 15 days at refrigerator temperature, the means of scores were 69, 61.8 and 57.33 points at doses 100, 200 and 300 Krad, respectively.

The flavour changed to very slight oxidized at 100 Krad and the change in flavour increased with increasing the radiation dose. After storage at the refrigerator temperature for 15 days, the flavour of irradiated buffaloes' milk improved than that stored for 7 days. The same effect was found earlier in this investigation with cows' milk.

These results are inagreement with many investigators who found that irradiation of milk caused oxidation to milk fat. Frazier (1967) recomended the addition of free radical acceptors, e.g. ascorbic acid to counteract oxidation. Luzac (1970,b) observed that rancidity increased with greater doses, indicating oxidation of the fat by irradiation. Ivanov and Stamatov (1976) found that low level of irradiation doses had only a slight effect on the oxidation of milk fat while medium and high level of irradiation doses increased its oxidation. It was found that medium and high level of irradiated fats and low level irradiated stored fats were not fit for consumption. The lower organoleptic evaluation of butter at relatively low oxidation was attributed to hydrolytic rancidity.

Concerning the effect of storage of the irradiated food on the organoleptic characteristics Mercuri et al. (1967) reported that irradiation of chickens with a dose level of *5 KGy produces objectionable off-odours in the raw meat that were still evident 2 to 4 days after storage at 4.4°C but could not be differentiated after longer storage periods. El-Mongy (1983) found clear differences in odour of irradiated chickens with 5 KGy. The differences

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* KGy = KGray = 10^5 rad = 100 Krad.

in odour decreased gradually and completely disappeared after 3 days. at cold storage. The findings of the aforementioned investigators are inagreement with the findings of this investigations on the effect of cold storage on the organoleptic characteristics of irradiated milk.

It appears from Table (46) that the thiobarbituric acid number in cows' milk fat (control) was 0.0.While after irradiated it was 0.109.

Table (46):- Effect of gamma radiation (300 Krad) on thiobarbituric acid number TBA in milk fat.

Samples of milk	Control (Non-radiated)	Radiated milk fat
Cow's	0.0	0.109
Buffaloe's	0.005	0.135

In buffaloes' milk fat the thiobarbuturic acid number in the control was 0.005 but it was 0.135 in irradiated milk fat. The increased of thiobarbuturic acid number in irradiated milk fat due to the increase in oxidation by irradiation.

These results are inagreement with Luzac (1970,b) who found that the thiobarbituric acid value of milk fat increased with greater exposure to gamma radiation indicating oxidation of the fat by irradiation. Also Wagner(1971) who found that peroxide is formed in oils and fats exposed to irradiation at doses of 0.5 to 2.0 Mrad. Ivanov & Stamatov (1976) and others found that low level of irradiation doses had only a slight effect on the oxidation of milk fat while medium and high level of irradiation doses increased its oxidation.

PART (4)

"PRODUCTION OF MUTANTS USUALLY USED IN DAIRY INDUSTRY"

1. Effect of Gamma Radiation on S.lactis counts and Acidity Production:

Table (47) shows that the counts of *S.lactis* decreased and the percentage of destruction increased as the doses of radiation were increased. The number *S.lactis* count per 1 ml was 125×10^7 in the control (Non-radiated) and 88×10^7, 270×10^6, 260×10^5 and 140×10^4 in irradiated milk at the doses 10, 50, 100 and 150 Krad, respectively. This corresponded to the percentages of destruction 29.6, 78.4, 97.95 and 99.88%, respectively.

Table (47) shows also the acidity production by *S.lactis* as control and isolates obtained from radiated treatments.

The acidity production increased by isolates of the 10 Krad treatment as compared with that of control. The acidity production by isolates of *S.lactis* of 50 Krad treatment showed more increment to reach the peak. Acidity production decreased by isolates of higher radiation treatments (100 and 150 Krad). The mean of the acidity production by S.lactis isolates of the control was 0.62, while the means of the acidity production increased by isolates of the 10 and 50 Krad treatments to be 0.65 and 0.70, respectively. The means of the acidity production by isolates of 100 Krad and 150 Krad treatments decreased than that of control isolates and were 0.53 and 0.509%, respectively.

The aforementioned results show that the mean of acidity production by the isolates of the dose 10 Krad was higher than control. However, the mean of acidity production by the 50 Krad isolates was the highest, and hence the 50 Krad dose could be considered as an activation dose for S.lactis starter for acidity production. As the radiation dose increased than 50 Krad, the mean of acidity production by the isolates of the treatment decreased.

Results in Table (47) show that two mutants were obtained. The acidity production by mutant I (from 10 Krad) treatment) was 0.95% and that of mutant (II (from

Table (47):- Effect of gamma radiation on the count and acid production of <u>S. lactis</u> inoculated in sterilized milk.

Dose	Total viable count/ ml.	Isolated No.	Acidity % produced by radiated and unradiated <u>S.lactis</u>															
			Isolate No.															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Control	$125x10^{7}$		0.62	0.62	0.63													
10	$88x10^{7}$	29.6	0.80	0.35	0.65	0.72	0.55	0.33	0.70	0.65	0.65	0.70	0.65	0.62	0.65	0.70	0.65	0.95
50	$270x10^{6}$	78.4	0.70	0.62	0.70	0.60	0.68	1.00	0.65	0.72	0.80	0.65	0.65	0.65	0.75	0.62	0.72	0.70
100	$256x10^{5}$	97.95	0.60	0.50	0.35	0.47	0.43	0.42	0.50	0.70	0.62	0.55	0.39	0.62	0.58	0.55	0.65	0.52
150	$140x10^{4}$	99.888	0.59	0.50	0.55	0.42	0.47	0.60	0.62	0.58	0.63	0.50	0.42	0.50	0.43	0.37	0.45	

Dose	Total viable count/ ml.	Isolated No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Mean
Control	$125x10^{7}$																0.62
10	$88x10^{7}$	29.6	0.85	0.75	0.65	0.70	0.75	0.62	0.60	0.50	0.70	0.75	0.62	0.60	0.70	0.65	0.65
50	$270x10^{6}$	78.4	0.70	0.65	0.75	0.65	0.62	0.80	0.85	0.62	0.65						0.70
100	$256x10^{5}$	97.95	0.70	0.67	0.50	0.55	0.45	0.43									0.53
150	$140x10^{4}$	99.888															0.59

50 Krad treatment) was 1.0% while the acidity of the control was 0.62%.

These results are inagreement with Jasjit and Ranganathan (1977) who observed that some mutants of L. bulgaricus and L.casei produced greater titratable and volatile acidities in milk, and they found that combining the mutant cultures with S.lactis or S.cremoris resulted in greater acid production ability than that of the parent cultures mixed.

Acidity production by S.lactis and its mutants at 30°C:

The acidity production by S.lactis and its mutants in sterilized skim milk at 30°C is given in Table (48)and illustrated by Figure (16). Table (48) shows that acidity increased in the control and reached the peak (0.75) after 28 hrs. then remained constant. The acidity increased by mutant I and mutant II till 30 hours, then remained constant at 0.97 and 1.01, respectively.

Results in Table (47) show that the two mutants were more active than the parent culture of S.lactis in the acid production. However, mutant II seemed to be more active than mutant I in the acid production. These results are in agreement with Jasjit and Ranganathan (1977).

Table (48):- Acidity production by S.lactis and its mutants when inoculated in sterilized skim milk and incubated at 30°C.

Time hrs.	Acidity		
	Control	Mutant I*	Mutant II**
2	0.27	0.27	0.27
4	0.29	0.29	0.29
6	0.30	0.33	0.33
8	0.32	0.36	0.37
10	0.35	0.38	0.39
12	0.37	0.41	0.43
24	0.65	0.90	0.93
26	0.70	0.93	0.97
28	0.75	0.96	0.99
30	0.75	0.97	1.00
31	0.75	0.97	1.01

* Obtained from 10 Krad treatment.

** Obtained from 50 Krad treatment.

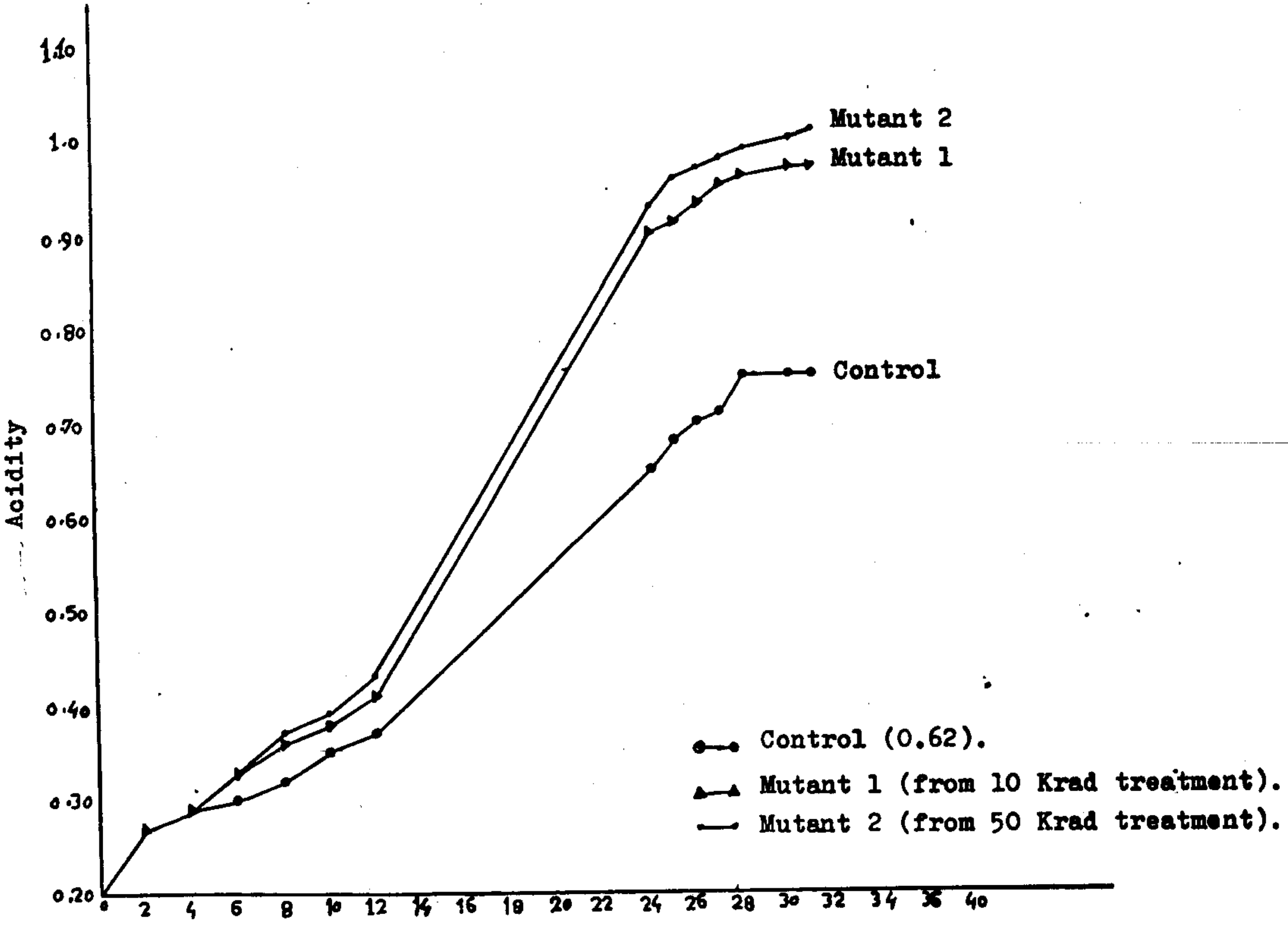

Fig. (16) :- Acidity production by S. *lactis* and its mutants.

Stability of acid production by S.lactis mutants:

Results in Table (49) show that the initial acidity of the control (S.lactis) was 0.62, and that for mutant I was 0.95% and for mutant II was 1.0%. This table also shows that the values of acidity produced by S.lactis (control) at the beginning, after 15, 30, 45 and 60 days were 0.62, 0.62, 0.61, 0.61 and 0.60 respectively. The values of acidity production by mutant I (S.lactis), directly after irradiation, after 15, 30, 45 and 60 days were 0.95, 0.89, 0.88, 0.86 and 0.87 respectively. By mutant II these values were 1.0, 0.90, 0.92, 0.89 and 0.89, respectively.

The aforementioned results indicate that the parent culture of S.lactis was stable in the acid production when inoculated in sterilized milk for 60 days.

Table (49):- Stability of S.lactis mutants in the acid production for 60 days.

Time in days	Acidity %		
	Control (0.62)	Mutant I (0.95) *	Mutant II (1.0) **
Initial	0.62	0.95	1.00
15	0.62	0.89	0.90
30	0.61	0.88	0.92
45	0.61	0.86	0.89
60	0.60	0.87	0.89

* Obtained from 10 Krad treatment.
** Obtained from 50 Krad treatment.

Acidity production by mutant I and mutant II slightly decreased by time. The decrease in the acid production by mutants, by passing time, may be due to that mutants try to repair their ruptured DNA trying to resemble their parent culture. However, after two months of the irradiated treatment, the mutants were more efficient (0.87% and 0.89%) than the parent S.lactis culture (0.60%) in the acid production.

Acidity production by isolates obtained from the re-irradiation of S.lactis mutants after 37 days:

Results in Table (50) show that acid production decreased by the isolates obtained from re-irradiation of mutant I and mutant II than acid production by their respective parent mutants. It also shows that the means of acidity produced by isolates from the re-irradiation of mutant I at 10,25 and 50 Krad were 0.83,0.772 and 0.768% respectively, while that of control (Mutant I) was 0.88. The respective means of acidity for isolates from the re-irradiation of mutant II were 0.846%, 0.81 and 0.773% while acidity of the control (mutant II) was 0.92%.

Table (50):- Acidity production by the re-irradiated mutants of S.lactis after 37 days at different doses of gamma rays.

Isolates	Mutant I				Mutant II			
	Con-trol	10 Krad	25 Krad	50 Krad	Con-trol	10 Krad	25 Krad	50 Krad
	Acidity % after 24 hrs.							
1	0.88	0.81	0.65	0.75	0.92	0.87	0.75	0.78
2		0.80	0.76	0.80		0.90	0.88	0.75
3		0.87	0.80	0.75		0.85	0.85	0.80
4		0.92	0.77	0.80		0.90	0.85	0.82
5		0.90	0.75	0.75		0.80	0.90	0.85
6		0.77	0.81	0.75		0.80	0.88	0.83
7		0.90	0.80	0.76		0.72	0.85	0.79
8		0.77	0.80	0.85		0.75	0.86	0.81
9		0.85	0.82	0.76		0.82	0.72	0.72
10		0.75	0.71	0.83		0.85	0.77	0.76
11		0.85	0.80	0.82		0.85	0.81	0.70
12		0.80	0.77	0.85		0.95	0.77	0.72
13		0.75	0.67	0.82		0.83	0.80	0.75
14		0.75	0.80	0.85		0.79	0.78	0.78
15		0.80	0.75	0.72		0.85	0.83	0.80
16		0.78	0.77	0.62		0.87	0.87	0.83
17		0.88	0.80	0.82		0.80	0.75	0.71
18		0.82	0.76	0.80		0.81	0.85	0.75
19		0.80	0.85	0.76		0.87	0.76	0.80
20		0.78	0.72	0.82		0.90	0.84	0.85
21		0.82	0.75	0.70		0.89	0.79	0.83
22		0.90	0.73	0.67		0.85	0.77	0.73
23		0.82	0.80	0.75		0.83	0.75	0.76
24		0.80	0.72	0.75		0.85	0.79	0.63
25		0.85	0.77	0.72		0.87	0.75	
26		0.87	0.88	0.80				
27		0.90	0.85	0.75				
28		0.85		0.82				
29		0.90		0.76				
30		0.86		0.65				
Mean		0.830	0.772	0.768		0.846	0.810	0.773

Results in Table (50) also show that re-irradiation of the mutants gave no new outstanding mutants.

Acidity production by isolates from the re-irradiated *S. lactis* mutants after 60 days:

Table (51) indicates that the acidity production in sterilized milk by isolates from the re-irradiated *S. lactis* mutants after 60 days were lower than the respective values of the isolates from the re-irradiation of the mutants after 37 days. Acidity produced by isolates from the re-irradiation of mutant I at 10, 25 and 50 Krad was 0.752%, 0.744% and 0.721%, respectively, while the means of mutant II the same doses were 0.806%, 0.786% and 0.732%, respectively.

Table (51):- Acidity production by the re-irradiated mutants of *S. lactis* after 60 days at different doses of gamma rays.

Isolates	Mutant I				Mutant II			
	Con-trol	10 Krad	25 Krad	50 Krad	Con-trol	10 Krad	25 Krad	50 Krad
	Acidity % after 24 hrs.							
1	0.87	0.72	0.80	0.72	0.89	0.77	0.70	0.72
2		0.73	0.68	0.70		0.73	0.75	0.70
3		0.70	0.80	0.68		0.82	0.90	0.73
4		0.81	0.77	0.76		0.91	0.80	0.75
5		0.80	0.70	0.70		0.82	0.75	0.67
6		0.80	0.73	0.72		0.79	0.80	0.74
7		0.75	0.80	0.71		0.83	0.75	0.68
8		0.77	0.75	0.65		0.85	0.81	0.65
9		0.73	0.77	0.73		0.87	0.75	0.69
10		0.71	0.72	0.75		0.80	0.77	0.79
11		0.73	0.75	0.73		0.72	0.76	0.82
12		0.78	0.72	0.76		0.77	0.82	0.77
13		0.72	0.70	0.77		0.74	0.87	0.75
14		0.75	0.70			0.76	0.82	0.74
15		0.79	0.78			0.92	0.75	0.78
Mean		0.752	0.744	0.721		0.806	0.786	0.732

* **Acidity of control isolates was 0.63.**

Diacetyl and acetoin production by S.diacetilactis isolates after 10 Krad gamma radiation treatment:

Table (52) shows the diacetyl and acetoin production in sterilized milk inoculated with isolates of S.diacetilactis after the gamma radiation treatment 10 Krad.

Data in Table (52) indicate that, in the control (S.diacetilactis) the diacetyl values of the replicates (mg./kg), were 1.5, 2 and 2; respectively. After irradiation treatment (10 Krad), two mutants (M1 and M2) were obtained which were potent in the diacetyl production. Five isolates produced double the amount of diacetyl, while one isolate produced 3 times the amount of diacetyl of the control. Results also show that 14 isolates, of the 10 Krad treatment, were similar to the control in the diacetyl production.

Data also show that diacetyl and acetoin production by mutant I (MI) were 50 and 292 mg/kg and those produced by mutant II(M2) were 57 and 499 mg/kg,respectively.

Table (52):- Diacetyl and acetoin produced in sterilized milk inoculated with isolates of S.diacetylactis after gamma radiation treatment (10 Krad).

Dose (Krad)	Isolates No.	Diacetyl mg/kg.	Diacetyl &Acetoin mg/kg.	Acetoin mg/kg
Control	1	1.5	262	260.5
	2	2	302	300
	3	2	342	340
	Mean	1.833	302	300.166
10 Krad	1	1.5	556	554.5
10 Krad	2	50	342	292
10 Krad	3	57	556	499
10 Krad	4	1.5	4	2.5
10 Krad	5	2	20	18
10 Krad	6	1.5	70	68.5
10 Krad	7	3	4.4	1.4
10 Krad	8	1.5	556	554.5
10 Krad	9	3	202	199
10 Krad	10	4	8	4
10 Krad	11	2	4	2
10 Krad	12	1.5	4	2.5
10 Krad	13	1.5	18	16.5
10 Krad	14	1.5	88	86.5
10 Krad	15	1.5	556	554.5
10 Krad	16	1.5	56	54.5
10 Krad	17	6	470	464
10 Krad	18	1.5	72	70.5
10 Krad	19	4	22	18
10 Krad	20	1.5	20	18.5
10 Krad	21	3	42	39
10 Krad	22	2	38	36
	Mean	6.931	168.563	161.63

Diacetyl and acetoin production by S.diacetilactis isolates after 50 Krad gamma radiation treatment:

Results in Table (53) indicate that out of the 21 isolates (after the dose 50 Krad treatment), one mutant of *S.diacetilactis* (M III) was obtained. The diacetyl and acetoin produced by this mutant (M III) were 32 and 176 mg/kg., while those of control were 1.833 and 300.16, respectively. The amounts of diacetyl produced by 14 isolates, of this treatment, were similar to that of control (1.5-2 mg/kg). While the remainder isolates (6 isolates) produced diacetyl double the amount of that of control.

Diacetyl and acetoin production by S.diacetilactis mutants after 100 Krad gamma radiation treatment:

Table (54) shows that out of 15 isolates, of the 100 Krad treatment, two mutants (M IV and M V) were obtained. Diacetyl and acetoin produced by mutant IV were 24 and 304 and those produced by mutant V were 26 and 94 mg/kg., while those of control were 1.8 and 300, respectively.

The aforemention results are inagreement with Shmeleva and Novotel(1975) who observed that irradiation

Table (53):- Diacetyl and acetoin produced in sterilized milk inoculated with isolates of *S.diacetylactis* after gamma radiation treatment, (50 Krad).

Dose (Krad)	Isolates No.	Diacetyl mg/kg.	Diacetyl &Acetoin mg/kg.	Acetoin mg/kg
Control	1	1.5	262	260.5
	2	2	302	300
	3	2	342	340
	Mean	1.833	302	300.16
50 Krad	1	2	30	28
50 Krad	2	4	356	352
50 Krad	3	5	8	3
50 Krad	4	32	208	176
50 Krad	5	2	10	8
50 Krad	6	1.5	556	554.5
50 Krad	7	3	83	80
50 Krad	8	1.5	8	6.5
50 Krad	9	2	6	4
50 Krad	10	2	6	4
50 Krad	11	1.5	16	14.5
50 Krad	12	4	14.8	10.8
50 Krad	13	1.5	6	4.5
50 Krad	14	3	123	120
50 Krad	15	1.5	177	175.5
50 Krad	16	1.5	220	218.5
50 Krad	17	1.5	18	16.5
50 Krad	18	3	14	11
50 Krad	19	1.5	442	440.5
50 Krad	20	1.5	12	10.5
50 Krad	21	1.5	528	526.5
	Mean	3.666	135.323	131.657

Table (54):- Diacetyl and acetoin produced in sterilized milk inoculated with isolates of *S.diacetlactis* after gamma radiation treatment, (100 Krad).

Dose (Krad)	Isolates No.	Diacetyl mg/kg.	Diacetyl &Acetoin mg/kg.	Acetoin mg/kg.
Control	1	1.5	262	260.5
	2	2	302	300
	3	2	342	340
	Mean	1.833	302	300.166
100 Krad	1	7	214	207
100 Krad	2	2	16	14
100 Krad	3	24	328	304
100 Krad	4	3	12	9
100 Krad	5	1.5	186	184.5
100 Krad	6	1.5	14	12.5
100 Krad	7	3	13.2	10.2
100 Krad	8	4	14	10
100 Krad	9	1.5	132	130.5
100 Krad	10	26	120	94
100 Krad	11	4	100	96
100 Krad	12	4	384	380
100 Krad	13	7	100	93
100 Krad	14	3	4	1
100 Krad	15	9	586	577
	Mean	6.7	148.213	141.513

caused only slight increase in diacetyl formation by S. lactis, appreciable increase by S.diacetilactis and marked increase by S.cremoris.

The results are also in accordance with Samaraeva et al., (1976) who exposed several strains of S.diacetilactis and S.cremoris to gamma radiation at 5 rad/sec. (100 Krad). Mutants vigorously producing diacetyl were selected by size of clear zone on solid calcium citrate. These results are inagreement with Odegov and Ostrumov(1976) they observed also that mutants of S.diacetilactis showed formation of 39 mg. diacetyl/L as compared to 2.75 for the parent organisms.

Data in Table (55) show the mean average of diacetyl and acetoin produced by S.diacetilactis isolates of the control and after the radiation treatments. The mean average of diacetyl and acetoin of the 3 isolates of control were 1.833 and 300.16 mg/kg., respectively.

After irradiation at the dose 10 Krad the mean average of diacetyl and acetoin were 6.931 and 161.631 mg/kg, respectively (from 22 isolates). At 50 Krad the mean of diacetyl and acetoin were 3.66 and 131.657 mg/kg, respectively, (from 21 isolates).

The mean average of diacetyl and acetoin were 6.7

Table (55):- The mean values of the effect of gamma radiation treatments on diacetyl and acetoin produced by isolates of S.diacetilactis.

Treatment	Diacetyl mg./kg	Diacetyl +Acetoin mg/kg.	Acetoin mg/kg
Control	1.833	302	300.166
10 Krad	6.931	168.563	161.631
50 Krad	3.666	135.323	131.657
100 Krad	6.700	148.213	141.513

and 141.513 mg./kg., respectively (from 15 isolates) at 100 Krad. Results show that at dose 10 Krad the mean average of the diacetyl and acetoin increased than that of the control and those of the other doses. (50 and 100 Krad).

This means that the dose 10 Krad treatment, (to the culture S.diacetilactis), is considered an activation dose to the strain for higher diacetyl production, many investigators were reported that the formation of diacetyl from acetoin is not a direct chemical oxidation but it is a biological oxidation, Thus, it can be concluded that the increase of diacetyl in some isolates (New mutants) can be decluced to the effect of gamma radiation in increasing the biological oxidation of some S.diacetylactis cells. In addition, Foster (1957) reported that their is considerable evidence to indicate that diacetyl arises primary from intermediates in the citrate fermentation, rather than from the biological oxidation of acetylmethyl-carbinol.

Stability of S.diacetilactis mutants in the diacetyl and acetoin production after different periods from radiation treatment:

Results in Table (56) indicate the stability of mutants directly after irradiation, 3 and 6 weeks after irradiation.

Results showed that the diacetyl and acetoin produced in the control were 2 and 340 mg/kg., respectively at the commencement and after 3 weeks were 2 and 348 mg./kg.,

Table (56):- Stability of S.diacetilactis mutants in the diacetyl and acetoin production after different periods from radiation treatment.

Dose Krad	Isolates	Diacetyl	Diacetyl &Acetoin	Acetoin	Diacetyl/Acetoin %
	Control *	2	342	340	0.588
	Control **	2	350	348	0.574
	Control ***	1.5	528	526	0.285
10	Mutant I *	50	342	292	17.123
	Mutant I **	11	340	329	3.343
	Mutant I ***	0.0	28	28	0.0
	Mutant II *	57	556	499	11.422
	Mutant II **	3	556	553	0.542
	Mutant II ***	0.0	27.6	27.6	0.0
50	Mutant III *	32	208	176	18.181
	Mutant III **	1.5	528	526.5	0.284
	Mutant III ***	0.0	326	326	0.0
100	Mutant IV *	24	328	304	7.894
	Mutant IV **	3	500	447	0.671
	Mutant IV ***	0.0	0.0	0.0	0.0
	Mutant V *	26	120	94	26.659
	Mutant V **	1.5	528	526.5	0.284
	Mutant V ***	1.0	29.6	28.6	3.496

* = Directly after irradiated.
** = 3 weeks after irradiated.
*** = 6 weeks after irradiated.

while after 6 weeks were 1.5 and 526 mg/kg., respectively. Mutant I(obtained from the 10 Krad treatment) produced diacetyl and acetoin 50 and 292 mg/kg., directly after irradiation; 11 and 329 mg/kg., after 3 weeks of irradiation and 0.0 and 28 mg/kg., after 6 weeks of irradiation.

Mutant II (obtained from 10 Krad treatment) produced diacetyl and acetoin 57 and 499 mg/kg., respetively, directly after irradiation; 3 and 553 mg/kg., respectively, after 3 weeks and 0.0, 27.6 mg/kg., respectively, after 6 weeks of the radiation treatment.

Mutant III(obtained from the 50 Krad treatment)produced diacetyl and acetoin directly after irradiation 32 and 176 mg./kg., respectively; 1.5 and 526.5 mg/kg., after 3 weeks and 0.0,326 mg/kg., respectively, after 6 weeks.

The production of diacetyl and acetoin by mutant IV (obtained from the 100 Krad treatment) produced diacetyl and acetoin directly after irradiation, 3 and 6 weeks after irradiation were 24 and 304 mg/kg., 3 and 447 mg/kg., and 0.0 and 0.0 mg/kg., respectively.

Mutant V(obtained from 100 Krad) produced diacetyl and acetoin 26 and 94 mg/kg., directly after irradiation,1.5 and 526.5 mg/kg., 3 weeks after irradiation and

1 and 28.6 mg./kg., respectively, 6 weeks after irradiation.

Diacetyl production increased by the mutants than the control.

Keeping the mutants at refrigerator temperature for 3 weeks and 6 weeks decreased their ability for diacetyl production to be zero after 6 weeks of storage.

Concerning the effect of gamma radiation on diacetyl and acetoin production by S.diacetilactis, the following conclusions were obtained:

- The irradiation of S.diacetilactis starter with 10 Krad gamma radiation, increased the ability of the starter organisms for diacetyl production in milk. So, the dose 10 Krád could be considered an activation dose for increasing diacetyl production by S.diacetilactis.

- The irradiation of S.diacetilactis yielded mutants potent in diacetyl production. These mutants lost their efficiency in diacetyl production by storage in the refrigerator for 6 weeks. This means that the physiological alteration was temporary due to the ability of the mutants to repair their ruptured DNA during cold storage. So, the author recommend further studies must be carried out, in the future, concerning methods and treatments to be applied to cause stability of the obtained mutants in diacetyl production.