



## SHELF LIFE ENHANCEMENT OF KHOYA BURFI BY GAMMA IRRADIATION TREATMENT

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### ABSTRACT

Due to increasing consumer requirements for extended product shelf-life, intelligent packaging of Indian sweets coupled with gamma irradiation, can create a huge international market and can lead to the uprising food processing industry of our country. In this study, we enhanced the shelf life of Khoya Burfi using gamma irradiation of the packaged Burfi by reducing the microbial load. Burfis were packed in polypropylene pouches, gamma irradiated (the doses selected were 0.50 kGy and 1kGy) for a period of 5 mins, and then one sample was stored at room temperature ( $25\pm 2^\circ\text{C}$ , RH  $80\pm 5\%$ ) and the other in the refrigerator. The microbial spoilage and appearance of irradiated and un-irradiated control samples were observed at regular interval of 3-5 days for 45 days. The microbial load was reduced considerably in irradiated samples (1 kGy) at room temperature with no bacterial and fungal growth till day 30, while countable colonies were observed after 30 days. On the other hand, too numerous to count (TNTC) colonies were observed in control samples after 5 days. Under refrigerated storage, the shelf life of packed irradiated Burfi increased to 45 days compared to only 10 days for the control Burfi pieces stored under the same conditions. There were no significant differences in sensory parameters and physico-chemical parameters such as moisture content, ash content, titratable acidity, and pH of the irradiated and control Burfi samples. This shows that irradiation does not affect the physico-chemical parameters of Burfi. However, the FFA values increased during storage at room temperature in both control and irradiated samples, but the increase was marginal under refrigeration. Also, the decrease in lactose content was observed during the storage of both the control and the irradiated samples.

**KEYWORDS:** Irradiation, Shelf life, Khoya, Burfi, Packaging, Polypropylene, Preservation.

### INTRODUCTION

Burfi is an Indian sweet. It is milk based, excellent culture medium for microbes having a shelf life of about ten days. Preparation of Burfi is done by Khoya- a heat thickened milk product obtained by evaporating buffalo or cow milk to a total solid content of approximately 70% (Sawhney et al. 1997). In order to promote exports and for consumer health & safety, a shelf life of 30-45 days is needed. Although one can achieve this by reducing water activity below 0.7, to retard microbial growth, but it could affect the product texture adversely. Also the sensory attributes of the product could be affected by the addition of humectants. (Thomas et al, 2008).

Electromagnetic radiations can be used to destroy microorganisms responsible for food spoilage. Irradiation in the packaging material can be done either after filling or prior. (Andrzej G. Chmielewski, 2006). The treatment with gamma and electron radiation is a well-known process used for the sterilization of

packaged foods. Keeping all this in mind, we aimed at increasing shelf life of Burfi by giving  $\gamma$ -irradiation dose of packaged Burfi samples packed in polypropylene pouches. The storage of the samples was done both at room temperature and under refrigeration for 45 days. The microbial load (total colony count, yeast and molds, coliform) in irradiated and control Burfi pieces were compared after regular intervals in two different storage conditions of room temperature and refrigeration. The study can provide a platform for further advanced studies and implication of the research work into commercialization of packaged irradiated Burfi with increased shelf life into international markets.

### MATERIAL AND METHODS

#### Raw material and chemicals

Freshly prepared Burfi was procured from "Haldiram", Moti Nagar, New Delhi. Polypropylene pouches were purchased from MORE Megastore, Moti Nagar, New Delhi.

The media components and other chemicals used in the study were purchased from Himedia Laboratories, Mumbai, India.

#### **Packaging and irradiation of Burfi samples**

The polypropylene pouches were disinfected using chlorinated water (25 ppm) and filled with one Burfi piece in each pouch under aseptic conditions. The filled pouches were given gamma irradiation (0.5kGy and 1kGy) for 5 minutes using Cobalt-60 as source at Shriram Institute for Industrial research, Delhi, but the control samples of sweets were not irradiated. The sweet pouches were ensured to have dose uniformity during the irradiation process. The storage of the irradiated and control Burfi pouches was done in a dry place and room conditions of  $25\pm 2^{\circ}\text{C}$ , RH  $80\pm 5\%$  and also some pouches were kept under refrigeration. The pieces were taken out at regular intervals of 3-5 days to 45 days for further studies.

#### **Total plate count for bacterial and fungal growth**

Burfi samples (both control and irradiated) were dissolved in peptone water and appropriately diluted. All the Burfi samples were inoculated onto nutrient agar plates and incubated at the temperature  $37^{\circ}\text{C}$  for the duration of 48 h to check for microbial growth. Similarly, all the samples were also inoculated onto DRBC (Dichloran Rose Bengal Agar) then incubated at  $30^{\circ}\text{C}$  for the duration of 72 h to check for yeast and mold growth.

#### **Sensory analysis**

Sensory evaluation was done for flavor, color, and, consumer acceptability of the treated and control Burfi sample.

#### **Proximate analysis**

Parameters like Moisture content, Ash content, total sugars, fat content and free fatty acid (FFA) values were estimated in both control and irradiated Burfi samples at regular intervals.

#### **Physical analysis**

Titration Acidity and pH control and irradiated samples was also studied at regular intervals up to 45 days.

### **RESULTS**

Total plate count for bacterial and fungal growth in Burfi stored at room temperature:

There was no bacterial growth on NA plates till 72 h (3 days) in both the control and irradiated samples. However, control sample showed heavy growth after 5 days of incubation. While, gamma irradiated burfi with 1 kGy dose showed no bacterial growth up to 30days, 0.5 kGy dose retarded bacterial growth in the sweets up to 15 days (Table 1).

There was no fungal growth in the inoculated dichloran rose Bengal chloramphenicol agar plate up to 10 days for both irradiated as well as control Burfi pieces. Fungal growth was seen in control Burfi samples after 15 days.

While the irradiated Burfi sample had no fungal growth till day-30 (Table 2).

Total plate count for bacterial and fungal growth in Burfi stored under refrigerated storage:

There was no bacterial growth on NA plates till 10 h (3 days) in both the control and irradiated samples. However, control sample showed heavy growth after 15 days of incubation. While, gamma irradiated burfi with 1 kGy dose showed no bacterial growth up to 40 days, 0.5 kGy dose retarded bacterial growth in the sweets up to 25 days (Table 1).

There was no fungal growth in the inoculated dichloran rose Bengal chloramphenicol agar plates up to 15 days for both irradiated as well as control Burfi pieces. Fungal growth was seen in control Burfi samples after 20 days. While the irradiated Burfi sample had no fungal growth till day-45 (Table 2).

Study of Moisture content, Ash content, Acidity, free fatty acid, iodine value, peroxide value and sensory properties of the control and irradiated samples stored at room temperature and refrigeration:

There were no significant differences in physico-chemical parameters such as Moisture content, Ash content, Titratable acidity, free fatty acid, iodine value and peroxide value of irradiated and control Burfi samples. (Table 3)

Proximate analysis of refrigerated Burfi (Table 4) showed that storage temperature affects the sensory, physico-chemical and textural properties of Khoya Burfi significantly:

The increase in the value of free fatty acid and peroxide value and decrease in iodine value indicates the development of rancidity in Burfi during storage at elevated temperature. This shows that irradiation does not affect the physical parameters of Burfi anyhow.

Besides, after studying sensory evaluations, one can conclude, that gamma irradiation does not make any noticeable change in texture, perfume, and color for acceptable consumer appeal. Refrigeration in addition to irradiation provides better texture and color/gloss to the Burfi.

**Table 1: Total plate count on Nutrient agar plates with control and irradiated Burfi samples.**

Storage Period (Days)	Control		Irradiation doses (0.5 kGy)		Irradiation doses (1 kGy)	
	Room Conditions	Refrigeration	Room Conditions	Refrigeration	Room Conditions	Refrigeration
0	ND	ND	ND	ND	ND	ND
3	TFTC	ND	ND	ND	ND	ND
5	$3.1 \times 10^3$	ND	ND	ND	ND	ND
7	$5.6 \times 10^4$	$4.6 \times 10^2$	ND	ND	ND	ND
10	$6.0 \times 10^6$	$9.1 \times 10^2$	ND	ND	ND	ND
15	TNTC	$7.9 \times 10^5$	$1.5 \times 10^3$	ND	ND	ND
20	TNTC	$4.1 \times 10^8$	$2.0 \times 10^4$	ND	ND	ND
30	TNTC	TNTC	$3.3 \times 10^5$	$6.9 \times 10^2$	ND	ND
45	TNTC	TNTC	$2.3 \times 10^9$	$3.6 \times 10^6$	$3.0 \times 10^4$	ND

**Table 2: Yeast and Mold count on dichloran rose Bengal chloramphenicol agar plates with control and irradiated Burfi sample.**

Storage Period (Days)	Control (0.0 kGy)		Irradiation doses (0.5 kGy)		Irradiation doses (1 kGy)	
	Room Conditions	Refrigeration	Room Conditions	Refrigeration	Room Conditions	Refrigeration
0	ND	ND	ND	ND	ND	ND
3	ND	ND	ND	ND	ND	ND
7	$1.2 \times 10^2$	ND	ND	ND	ND	ND
10	$2.5 \times 10^4$	$1.6 \times 10$	ND	ND	ND	ND
15	$6 \times 10^4$	$4.2 \times 10^2$	ND	ND	ND	ND
20	$4.3 \times 10^5$	$3.9 \times 10^4$	ND	ND	ND	ND
30	$3.9 \times 10^6$	$2.3 \times 10^4$	$2.8 \times 10^4$	ND	$3.3 \times 10^3$	ND
45	$5.2 \times 10^8$	$1.1 \times 10^5$	$4.7 \times 10^5$	$5.2 \times 10^2$	$4.5 \times 10^4$	ND

**Table 3: Physico- Chemical parameters of gamma irradiated Burfi during the experimental storage period at room temperature.**

Storage Period	Day 7			Day 15			Day 30			Day 45		
	Control	0.5 kGy	1 kGy									
Moisture Content (%)	11.94	12.01	12.33	11.11	11.06	11.9	10.17	10.28	10.3	10.01	10.11	10.04
Ash Content (%)	2.42	2.38	2.44	2.34	2.29	2.40	2.34	2.14	2.36	2.28	2.10	2.33
Acidity (%)	0.32	0.36	0.37	0.35	0.37	0.38	0.38	0.42	0.41	0.41	0.46	0.49
Free fatty acids (%)	0.026	0.025	0.026	0.027	0.026	0.026	0.029	0.026	0.027	0.029	0.028	0.028
Iodine value	80	81	80	79	80	80	76	80	80	75	78	79
Peroxide value (meq/kg)	0.37	0.37	0.38	0.40	0.38	0.38	0.43	0.41	0.40	0.45	0.43	0.42

**Table 4: Physico- Chemical parameters of gamma irradiated Burfi during experimental storage period at Refrigeration.**

Storage Period	Day 7			Day 15			Day 30			Day 45		
	Control	0.5 kGy	1 kGy									
Moisture Content (%)	12.24	12.19	12.20	12.11	12.06	12.00	11.97	11.88	11.92	11.59	11.83	11.89
Ash Content (%)	2.55	2.42	2.51	2.42	2.36	2.46	2.40	2.21	2.42	2.37	2.18	2.39
Acidity (%)	0.37	0.39	0.35	0.36	0.40	0.33	0.37	0.41	0.37	0.34	0.36	0.39
Free fatty acids (%)	0.022	0.023	0.024	0.026	0.023	0.025	0.028	0.024	0.025	0.026	0.027	0.026
Iodine value	79	80	82	75	78	80	75	77	78	73	75	76
Peroxide value (meq/kg)	0.36	0.36	0.39	0.39	0.37	0.40	0.42	0.40	0.41	0.43	0.44	0.44

**CONCLUSION**

Food packaging is considered to be the final step in food processing. It is said to be a critical step for a incorporating antimicrobial mechanism to control the contamination post processing. Therefore, in the present

work, we reduced the microbial load in Khoya Burfi by irradiation after packaging it in the polypropylene pouches. The results revealed that irradiated product could remarkably retard the rate of microbial proliferation. Moreover, it was observed that irradiation

of sweets at 1kGy dose coupled with cold storage increases the shelf life of the product remarkably than when applied singly. The shelf life of irradiated Burfi stored under refrigeration to be 45 days compared to only 10 days from the control pieces stored under similar conditions. Similarly, irradiation also enhances the shelf life of the packaged Burfi which was stored under room temperature till 30 days.

Therefore, by the study it can be concluded that, Gamma irradiation can be utilized to increase the shelf life of Burfi under the vast Agra-climatic conditions of India. Further research needs to be carried out to verify any change in nutritive value and organoleptic characteristics after the irradiation.

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