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Effect of Microwave Radiation on Shelf Life of *Barfi*

Rakesh Kumar[1*], Binita Rani[2], K. Dalmia[3] and B.K. Singh[4]

[1]Department of Dairy Microbiology, Faculty of Dairy Technology, SGIDT, Jagdeo Path, Patna, India
[2]Dairy Chemistry, Faculty of Dairy Technology, SGIDT, Jagdeo Path, Patna, India
[3](Dairy Technology), Faculty of Dairy Technology, SGIDT, Jagdeo Path, Patna, India
[4]SMS (Home Science), KVK, Arwal Bihar, India

**Corresponding author*

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A B S T R A C T

Attempts were made to enhance the shelf life of *Burfi* by microwave irradiation. Standard Plate Count; Coliform Count; Yeast and Mold Count; Proteolytic Count; Acid Producers Count; Staphylococcus Count and Sensory evaluation on a nine point Hedonic Scale of each product i.e. treated and untreated products stored at ambient condition (30˚C) and at refrigerated condition (5 - 7˚C) was done at 0 day, 2nd day, 5th day, 7th day and onward till they were acceptable based on organoleptic test and consumer acceptance. The shelf life of *Burfi* was extended by 19 days at room temperature and 28 days at refrigeration temperature. Use of microwave radiation of *Burfi* is suggested to enhance the shelf life of the product.

Introduction

From very early time the simplest way to enhance the keeping quality of milk is boiling. Many thermal processes i.e. pasteurization, sterilization and UHT have gained a lot of popularity. However, many drawbacks are also related to this process of heat treatment viz. degradation of flavour and colour, nutrients, etc. Therefore alternative and safest method was searched throughout the world for any possible physical method. Present study was conducted to analyze the effect of microwave radiation on the shelf-life of *Burfi*. *Burfi* is a khoa based sweet popular throughout the Country. The presence of *E. coli* in almost all the samples of raw milk samples and other milk products like mawa/khoa, dahi cheese etc. have been reported (Haq *et al.*, 1995 and Soomoro *et al.*, 2002). Many studies carried out in India showed a very high contamination level besides the presence of pathogenic microorganisms such as *Staphylococcus* sp, *Bacillus* etc. (Gill *et al.*, 1994; Mandokhot and Garg., 1986). *Staphylococcus sp.* is most

frequently occurring organism in sweet based milk products such as khoa, rabri, gulabjamun etc. (Grewal and Tiwari, 1990; Hamama and Tatini, 1991). Millions of people are affected by food borne illness resulting from ingestion of toxin produced by food associated *Staphylococcus*. Microwave treatment is an intense thermal process, which is now widely used to extend the shelf life of various food products. It is well established that the microflora of liquid milk could be reduced by microwave treatment (Anon, 1989). Non-thermal effects were demonstrated in the early work of Fleming (1944). However, Olsen *et al.,* (1966) was the first person who postulated the non-thermal effects of microwave heating. It has also been observed that in pasteurized milk with microwave, microbial population was lower than untreated milk and has longer shelf life. A number of studies have reported successful microwave pasteurization of milk (Hamid *et al.,* 1969; Knutson *et al.,* 1988). Villamiel *et al.,* (1996) concluded that continuous microwave processing might be an efficient and mild method for the pasteurization of milk. They also concluded that shelf life of microwave treated milk was longer than that of milk heated in plate heat exchanger. Kindle, *et al.,* (1996) reported that colony counts of all microorganisms were significantly decreased by microwave heating. However, industrial microwave processing of food did not develop rapidly due to lack of information on product safety and quality (Mudgett, 1986). A microwave oven works by passing non ionizing microwave radiation through the food. Microwave radiation is between common radio and infrared frequencies. The other major mechanism of heating with microwaves is through the polarization of ions as a result of the back and forth movement of the ionic molecules trying to align themselves with the oscillating electric field (Oliveira and Franca, 2002). Keeping in view of the above said information this study was planned and conducted to examine the effect of microwave treatment on different attributes responsible for improving shelf life of a very popular sweet of east India i.e. *Burfi*.

Materials and Methods

Samples of indigenous milk product *Burfi* were procured under aseptic conditions from the local market. All the products were separately packed in polypropylene pouches (75μ thickness and dimension 4 ″ X 3″) aseptically, as suggested by Mathur *et al.,* (1992). Two container of each sample were microwave treated and other two were kept as control. *Burfi* were treated at power level 40 (i.e. 400w) for 7 sec. Power level and time combination was chosen based on their effect on taste, body and texture. The treated samples were kept under refrigerated condition (5˚C) and under ambient temperature (30˚C). Standard Plate Count, Coliform Count, Yeast and Mold Count according to the methods of BIS (1960); Proteolytic Count (according to the methods of Harrigan and McCance, 1976), Acid Producers Count (ISI: SP: 18); *Staphylococcus Count* (Chapman, 1946) and Sensory evaluation on a nine point Hedonic Scale was done for each product i.e. treated and untreated products stored at ambient condition and at refrigerated condition at 0 day, 2nd day, 5th day, 7th day and onward till they were acceptable based on organoleptic test and consumer acceptance.

Results and Discussion

Effect of microwave treatment on the microbiological quality of indigenous milk products

Effect on standard plate count

In general the total plate count decreased due to microwave treatment and increased both in

treated and untreated sample during storage (Table 1). The total plate count in fresh *burfi* sample was 17 $X10^4$ cfu /gm, respectively. It was observed that after microwave treatment the average reduction in total plate count was about 41% in *burfi* samples.

Effect on coliform count

Growth of coliform was also affected by microwave treatment. The coliform count in burfi was 140 cfu /gm. Reduction in coliform count by microwave treatment was 57% in *burfi.* However, Fujikawa *et al.,* (1992) reported the destruction of *E. coli* and *S. aureus* by the same microwave treatment.

Effect on yeast and mold count

There was no significant change in yeast and mold count as compared to other microbial count due to microwave treatment of *Burfi.* Yeast and mold count of *burfi* before treatment was $12X10^2$ cfu /gm and after irradiation, the percent reduction in yeast and mold count was 33% in *burfi*.

Similar results were observed by Culkin and Fung (1975) who reported that microwave heating at 2450 MHz caused little or no destruction of *Aspergillus, Penicillium, Rhizopus* etc. in foods.

Effect on proteolytic count

The proteolytic count was lower in microwave treated sample than in untreated sample. It was observed that the proteolytic count 21 X 10^2 cfu /gm. It was observed that reduction rate of proteolytic bacteria due to microwave treatment was 57% in *burfi*.

Effect on acid producers count

Acid producers count also reduced due to microwave treatment. In case of burfi 54.5% reduction of acid producers count was observed (Table 2).

Effect on *Staphylococcus* count

No *Staphylococcus* was detected in fresh *burfi.* After microwave treatment *Staphylococcus* counts in *burfi*.

According to Odani (1995) observed that the pasteurization time for killing of *Staphylococcus aureus* was approximately 50˚C. He suggested that the mechanism of killing of bacteria depend not only on temperature but also on other effects of microwave irradiation.

Sensory evaluation

The sensory score for flavour, colour, consistency and appearance of microwave treated *burfi* was observed to be same as compared to untreated products.

Effect of microwave treatment on the microbiological quality of *Burfi* during storage

Effect on standard plate count

Fresh *burfi* having 17 X 10^3 cfu/gm, after 12 days of storage at room temperature (34˚C) it spoiled and that time SPC count increased to 83 X 10^4 cfu/gm.

When the samples were kept under refrigerated condition, *burfi* spoiled after 23 days and count rose to 95 X 10^4 cfu/gm.

Treated *burfi* initially having a plate count of 10 X 10^3 cfu/gm spoiled within 19 days when kept under ambient condition (SPC rose to 98 X 10^3 cfu/gm) and spoiled after 28 days when stored in refrigerated condition (SPC increased to 92 X 10^3 cfu/gm). Similar results were observed by Kindle *et al.,* (1996).

Table.1 Effect of microwave treatment on *Burfi*

Sr. No.	Parameter	Before (cfu/g)	After (cfu/g)	Reduction (%)
1.	Standard Plate Count	17,000	10,000	41.1
2.	Coliform count	140	60	57.1
3.	Yeast and Mold Count	1200	800	33.3
4.	Proteolytic Count	2100	900	57.1
5.	Acid producers count	220	100	54.5
6.	*Staphylococcus* count	Nil	Nil	--

Table.2 Effect of microwave treatment on *Burfi* during storage

Parameter	Sample	Burfi	
		Count at 0 day	Count at the day of spoilage
SPC	Untreated (at room temp.)	17000	83000@12day
	Untreated (at refrigeration temp.)	17000	95000@23day
	Treated (at room temp.)	10000	98000@19day
	Treated (at refrigeration temp.)	10000	92000@28day
Coliform	Untreated (at room temp.)	140	470@12day
	Untreated (at refrigeration temp.)	140	550@23day
	Treated (at room temp.)	60	560@19day
	Treated (at refrigeration temp.)	60	600@28day
Yeast & mold count	Untreated (at room temp.)	1200	9900@12day
	Untreated (at refrigeration temp.)	1100	9800@23day
	Treated (at room temp.)	800	9700@19day
	Treated (at refrigeration temp.)	800	10200@28day
Proteolytic count	Untreated (at room temp.)	2100	5900@12day
	Untreated (at refrigeration temp.)	2100	8100@23day
	Treated (at room temp.)	900	6100@19day
	Treated (at refrigeration temp.)	900	8600@28day
Acid Producers count	Untreated (at room temp.)	220	1100@12day
	Untreated (at refrigeration temp.)	220	1020@23day
	Treated (at room temp.)	100	1050@19day
	Treated (at refrigeration temp.)	100	980@28day
Staphylococcus count	Untreated (at room temp.)	0	0@12day
	Untreated (at refrigeration temp.)	0	0@23day
	Treated (at room temp.)	0	0@19day
	Treated (at refrigeration temp.)	0	0@28day

Effect of coliform count

In fresh *burfi* coliform count was 14X 10 cfu/gm. After microwave treatment the count reduced to 6 X 10 cfu/gm. Untreated sample spoiled after 12 days of storage at room temperature when count increased to 47 X 10 cfu/gm and spoiled after 23 days of storage under refrigerated condition when count rose to 55 X 10 cfu/gm. Treated *burfi* sample was spoiled after 23 days under ambient condition and count increase to 56 X 10 cfu/gm and spoiled within 28 days under refrigerated condition when count increase to 60 X10 cfu/gm.

Effect of yeast and mold count

Fresh *burfi*, having yeast and mold count 12 X 10^2 cfu/gm was spoiled after 12 days of storage at room temperature (count increased to 99 X 10^2cfu/gm) and spoiled by 23 days of storage under refrigerated condition (count increased to 98 X 10^2cfu/gm). Treated *burfi* sample (initially yeast and mold count was 8 X 10^2 cfu / gm) damaged by 19 days of storage at room temperature (yeast and mold count 97 X 10^2cfu/gm) and by 28 days of storage under refrigerated condition (yeast and mold count 102 X 10^2cfu/gm). Culkin and Fung (1975) reported microwave treatment at 2450 MHz caused greater destruction of *Aspergillus*, *Penicillium*, *Rhizopus* etc. in foods than heating alone.

Effect on proteolytic count

In case burfi fresh sample (proteolytic count 21 X 10^2 cfu/gm) spoiled by 12 days when stored at room temperature (proteolytic count rose to 59 X 10^2 cfu/gm) and spoiled by 23 days when stored under refrigerated condition (proteolytic count rose to 81 X 10^2 cfu/gm). In case of treated sample (proteolytic count 9 X 10^2 cfu/gm) spoiled by 9 days when stored at room temperature (proteolytic count rose to 62 X 10^2 cfu/gm) and spoiled by 28 days when stored under refrigerated condition (proteolytic count rose to 91 X 10^2 cfu/gm).

Effect on acid producers count

Number of acid producer's colonies in fresh burfi was 22 X 10^2 cfu/gm and increased to 61 X 10^2 cfu/gm after 9days when it stored at room temperature and to 92 X 10^2 cfu/gm after 23 days under refrigerated condition. The count at microwave treated (600W for 30sec.) was 10 X 10^2 cfu/gm and increased to 59 X 10^2 cfu/gm after 12 days when it stored at room temperature and to 81 X 10^2 cfu/gm after 28 days under refrigerated condition. Kozempel (1998) observed similar result.

Effect on *Staphylococcus* count

Microwave treatment (600W for 30sec) had a significant inhibitory effect on survival of *Staphylococcus* spp. in burfi sample *Staphylococcus* spp was absent in 1st dilution. Similar result was observed by Hammad (1998).

Sensory evaluation

The sensory score for flavour, colour, consistency and appearance of microwave treated burfi were observed to be same as compared to untreated products. On the basis of organoleptic evaluation it was observed that the quality of burfi before and after treatment were almost same. During storage the overall acceptability of control sample was decreased to a greater extend than those of microwave treated sample. Microwave treated samples of burfi stored under refrigerated condition was evaluated for 28 days, whereas untreated *Burfi* stored under refrigerated condition was evaluated for 23 days. During storage colour and appearance, smell of both the product was more affected than body and texture. Colour and appearance

more quickly deteriorated due to mold growth and taste and flavour deteriorated due to acid producer's bacterial growth. Mathur *et al.*, (1992) observed similar results in paneer.

Microwave treated *Burfi* samples were evaluated for 19 days at room temperature whereas under refrigerated condition it was evaluated for 28 days. Control sample of untreated *Burfi* was evaluated for 12 days at room temperature and 23 days at at refrigeration temp respectively. During storage, colour and appearance, smell of *Burfi* was more affected than body and texture. Colour and appearance more quickly deteriorated due to mold growth and taste and flavour deteriorated due to acid producers' bacterial growth. It has been reported that microwave treatment of *Burfi* up to 115˚C for 5m did affect the body and texture and flavour attributes of the product and increase the shelf life and can be effectively utilized for fulfilling the local rural market demand.

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