

DEVELOPMENT AND EVALUATION OF SHELF STABLE PARTIALLY BAKED CHAPATTI USING THERMAL PROCESSING

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ABSTRACT

Chapatti is a major traditional staple food in Indian subcontinent which is unleavened flat bread made from whole wheat flour, vegetable oil, salt and water. The present investigation attempts to study the feasibility of extending the shelf life of partially baked chapatti by retort pouch processing. The partially baked Chapattis were packed in polypropylene pouches of 100 microns and subjected to retort processing. The partially baked retort processed pouches were stored at ambient temperature to study the effect of storage temperature on shelf life of the product. These chapattis were evaluated for microbial quality and sensory quality at regular intervals for a period of nine weeks. Microbial analysis showed retort processed chapatti stored at ambient temperature was microbiologically safe for more than eight weeks. Retort processed partially baked chapatti stored at ambient conditions scored highest mark in sensory evaluation in terms of color, aroma, texture, and overall acceptability.

Key words: Partially baked Chapatti, Retort processing, extended shelf life, microbiologically safe, polypropylene pouches

I. INTRODUCTION

Freshly baked Chapattis are soft, pliable and elastic but when kept at room temperature they stale within few hours and become tough and rigid within two days they will spoil. Further there is a growing demand for traditional foods in convenient forms of consumption and handling. Therefore, there is a need for the mechanization of traditional Chapatti manufacture practice combined with ideal packaging

to extend the shelf life of the chapatti and bring them to a convenient form (Arya, 1984).

Chapattis preserved in ready-to-eat form is ideally suited for operational situations where cooking facilities become limited or non-existent. Despite huge marketing potential, commercial marketing chapattis has not picked up due to high perishability. The shelf life of freshly baked chapattis is 24-36h and they become unfit for consumption due to development of mold growth, ropiness and texture deterioration depending upon storage conditions (Arya et al., 1986). Therefore, attempts were made to extend the shelf life of partially baked Chapatti that is microbiologically safe and requires minimal preparation by the consumer.

II. REVIEW OF LITERATURE

Majority of the wheat milled in India is consumed in the form of chapatti. Traditionally, wheat is ground in a chakki (grindstone) and sieved to remove the coarsest particle of bran resulting in a flour of over 90% extraction rate. This flour is a good source of dietary fibre and the high starch damage caused by the stone mill results in an increased water absorption capacity of the flour, yielding softer and more pliable chapattis. (Gujral and Pathak, 2002; Gujral and Gaur, 2002).

Studies about Preservation of Chapattis and Parotas indicated that Chapattis could be preserved on a short term basis for a period of 10-14 days by incorporating sorbic acid and then packaging in polythene pouches. Heating the Chapattis by dipping the polythene pouch in hot water improved the

acceptability of the Chapattis. The method is simple and can be easily adapted in any kitchen without any additional facilities. The Chapattis packaged in paper foil laminate pouches could be preserved for 6 months. Incorporation of fat, milk powder and oleoresins of cumin seeds and cardamom improved the texture and flavour and acceptability of preserved Chapatis. (Sharma, 1984).

The microbial deterioration that occurs in chapatti can be controlled by adding chemical additives (Ghosh et al., 1973; Arya and Vidhyasagar, 1981). The textural changes occurring in chapatti are very rapid and begin as soon as chapatti is baked which affects the acceptability of the product. Some attempts of retarding chapatti staling consisted in the use of different hydrocolloids such as guar gum, carboxymethylcellulose and k-carrageenan (Gujral et.al. 2004; Shalini and laxmi, 2007). Chapatties has to be stored at refrigerated temperature to avoid mold growth. (Hardeep Singh et al., 2008) There is a good possibility that commercial production of chapatti may start in near future due to steadily developing urbanization.

III. MATERIALS AND METHODS

A) MATERIALS

1. RAW MATERIALS: The various raw materials used for preparation of chapatti were wheat flour, oil, water and salt. All the ingredients were freshly purchased from the local market. Water was taken from the department aquaguard.

2. PACKAGING MATERIAL: Packaging material used for the current study was Polypropylene films of 100 microns with dimensions 10 x 11 cm.

B) METHODS

1. PRODUCT STANDARDIZATION

Product standardization is the most critical steps in processing. The acceptability and sensory quality of the product mostly depend upon standardization. For the preparation of chapatti, various combinations of wheat flour, vegetable oil and other ingredients were tried and the recipe and was standardized based on

the sensory attributes. The standardized quantities required for preparation of chapatti are wheat flour (100g), oil (10ml), water (60ml) and salt (1.8g).

2. METHOD OF PREPARATION OF RETORT PROCESSED CHAPATTI

The flowchart for preparation of Retort processed Chapatti has been shown in Fig 1. The flour was sieved through 400 μ m mesh size and a weighed quantity of flour was transferred into the dough kneader and mixed at a mixing speed of 700 rpm for 4 minutes. Weighed quantity of salt was dissolved in water in a stainless steel vessel and added to dough kneader and mixed for 1-2 min. Vegetable oil of required quantity was heated at 90°C and added to the dough and all the ingredients thoroughly mixed in dough kneader for about 10mins to obtain desired consistency. After mixing, the dough was kept for covered under a muslin cloth for proofing for 1 hour. The dough was then divided into circular balls of 30g each. The dough was sheeted using a dough pressing machine under a pressure of 100kg/m² for 2sec to get a thin circular sheet of chapatti 6 inch in diameter and 1 mm thick. The sheeted dough was placed on a hot plate (250°C) and baked for 12s on one side and 10s on the other side. The partially baked chapattis were then dusted with tapioca starch on both sides in order to prevent adhesion of chapattis to each other after packaging. Fig 2, 3 and 4 shows picture of dough mixing, cutting and sheeting respectively.

3. THERMAL TREATMENT & STORAGE

The partially baked Chapatti packed in PP pouches was subjected to thermal treatment to control the growth of spoilage and pathogenic microorganisms. To determine the processing time and temperature, partially baked chapatti packed in PP pouch were retort processed to achieve commercial sterility in a pilot-scale steam-air retort maintained at 95° C, Overhead air pressure of 10 psi was used during processing and cooling. Thermal processed chapattis were stored at ambient conditions for a period of 8 weeks.

4. SHELF LIFE ANALYSIS:

The thermally processed chapatti pouches were labeled for sample name, date of processing,

processing conditions and storage conditions. Each week, the samples were withdrawn from the storage and microbiological followed by sensory analysis was done.

MICROBIOLOGICAL EVALUATION:

Microbiological parameters namely Mesophilic aerobic bacteria, Mesophilic Sporeformers, Coliforms (*E coli*), Yeast and molds count were determined initially and during the storage at specific intervals by standard procedure of APHA (2001).

SENSORY EVALUATION: The partially baked chapattis was re-baked for 15s on one side and 10sec on other side and cooled for 5min before evaluation. The re-baked chapattis were evaluated for sensory parameters like, appearance, pliability, aroma, texture, eating quality. Ten trained panel members were requested to evaluate the chapatti for sensory attributes. The overall quality of thermally processed partially baked chapatti was determined on the basis of the score obtained by all attributes.

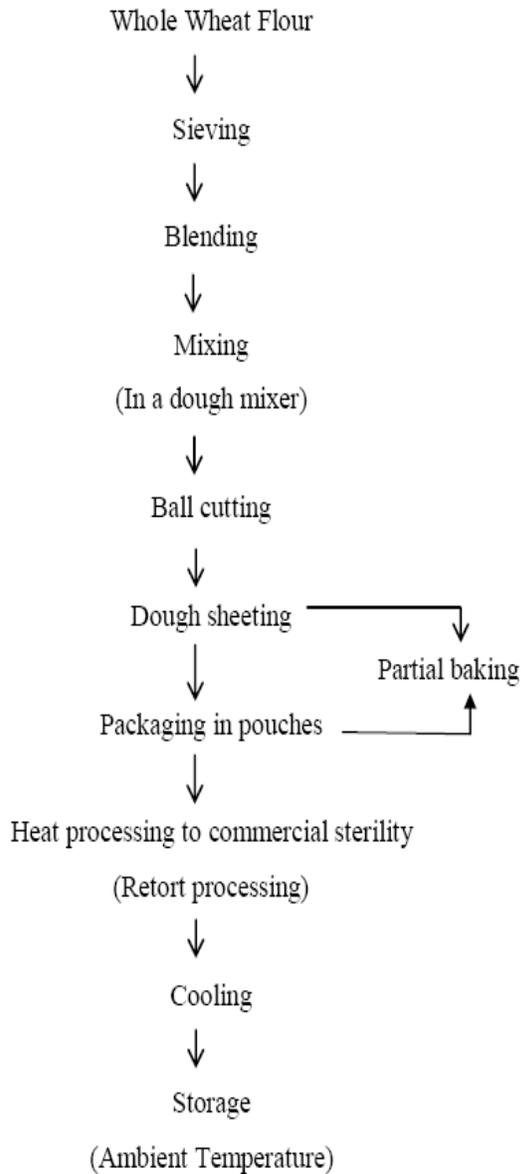


Fig 1: Flow chart for Preparation of Retort Processed Chapatti



Fig 2: Mixing of Dough



Fig 3: Dough Cutting

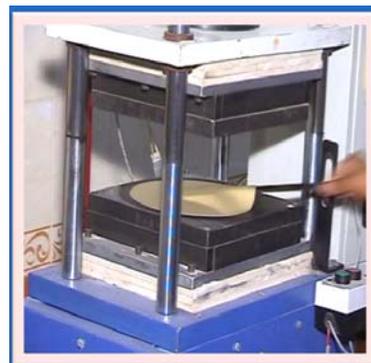


Fig 4: Sheeting of Dough

III. RESULTS AND DISCUSSION

Various studies have been conducted to study the feasibility of extending the shelf life of Partially Baked Chapatti that is microbiologically safe and requires minimal preparation by the consumer. The investigation focused on:

1. Thermal Treatment: Heat penetration study to determine processing time and temperature for complete sterilization.
2. Shelf life analysis (microbiological and sensory analysis) to determine the safety and acceptability of the product.

1. THERMAL TREATMENT

The partially baked chapattis were processed by retort pouch technology. The heat penetration study was plotted between time (min) vs. temperature ($^{\circ}\text{C}$) and the F_{70} value in min was obtained. During the study, partially baked chapatti packed in PP pouch were retort processed to achieve commercial sterility maintained at 95°C for 15min, Overhead air pressure of 10 psi was used during processing and cooling. After, a period of 15 min, the products were cooled gradually to 40°C which is also depicted in the graph. In this study, considering F_{70} value for 10 min indicates that 4.5 min is the minimum time required for processing partially baked chapatti to attain commercial sterility. Heat penetration study of retort processed partially baked chapatti is shown on Fig 5.

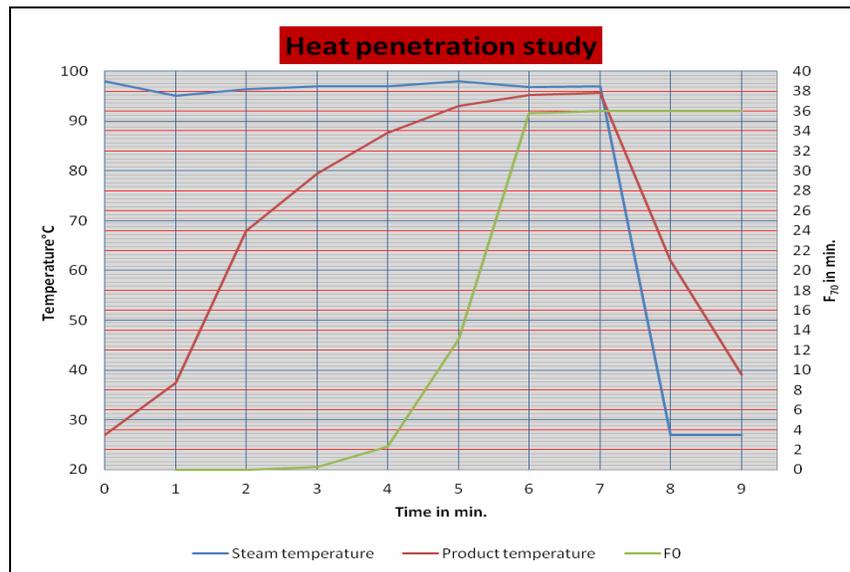


Fig.5 Heat Penetration study of Partially Baked Chapatti

2. MICROBIOLOGICAL ANALYSIS

Microbiological Profile of Retort processed partially baked chapattis stored under ambient conditions is shown in Table1 which clearly depicts the growth of yeast and mold, coliforms, mesophilic aerobes and mesophilic sporeformers in various chapatti samples. From Table 1, it can be seen that on 0th day, total count of mesophilic aerobes in unprocessed sample were under control limits; however the total mesophilic aerobes count exceeded (17

$\times 10^2$) control limit on 3rd day. In addition, the samples also showed the growth of coliforms which indicates that unprocessed chapattis were microbiologically safe for consumption only for a period of 2 days. (FPO specifications, Rangana, 2001).

Retort processed partially baked chapatti stored at ambient conditions initially has shown no growth of mesophilic aerobes, yeast and mold, and coliforms. During 9th week, growth of mesophilic aerobes exceeding control limits ie. 3×10^1 . The growth of Mesophilic sporeformers was also found during 9th week of storage. The growth of coliforms and yeast and mold is not observed throughout the storage period. Hence, the study proved that retort processed partially baked chapatti were microbiologically safe only for eight weeks if stored at ambient temperature.

TABLE 1: MICROBIOLOGICAL PROFILE OF RETORT PROCESSED PARTIALLY BAKED CHAPATTI STORED UNDER AMBIENT CONDITIONS

Sample	Storage conditions		Yeast and Mold (cfu/g)	Coliforms (cfu/g)	Mesophilic Aerobes (cfu/g)	Mesophilic aerobic Sporeformers (spores/g)
	Temperature (°C)	Duration				
Unprocessed partially baked Chapatti	Ambient Temperature	0 th day	2	ND	3×10^2	1×10^2
		3 rd day	5×10^1	1×10^2	17×10^2	4×10^2
		0 th day	ND	ND	ND	$<1 \times 10^1$
1 st week		ND	ND	ND	$<1 \times 10^1$	
2 nd week		ND	ND	ND	$<1 \times 10^1$	
3 rd week		ND	ND	ND	$<1 \times 10^1$	
4 th week		ND	ND	ND	$<1 \times 10^1$	
5 th week		ND	ND	ND	$<1 \times 10^1$	
6 th week		ND	ND	ND	$<1 \times 10^1$	
7 th week		ND	ND	ND	$<1 \times 10^1$	
Retort processed partially baked Chapatti	8 th week	ND	ND	ND	$<1 \times 10^1$	
	9 th week	ND	ND	3×10^1	2.2×10^2	

ND: Not detected (absent in 1:10 dilution of the sample)

3. SENSORY ANALYSIS

The sensory evaluation of the retort processed partially baked chapatti is shown in Table 2. Retort processed partially baked chapatti stored at room temperature remained highly stable and highly acceptable even after storage of 8 weeks under ambient conditions. From Table 2, it clearly indicates that the overall quality of the product decreased slightly from 9.2 to 8.08 during the storage period from 0-8 weeks. Fig 6 depicts the Sensory profile of Retort Processed Partially Baked Chapatti represented by the spider web diagram.

TABLE 2: SENSORY EVALUATION OF RETORT PROCESSED PARTIALLY BAKED CHAPATTI

Sample	Storage period (weeks)	Colour & Appearance (20)	Texture (30)	Aroma (10)	Taste (30)	Overall Quality (10)
Partially Baked Retort Processed Chapatti	0	19.4	22.1	9.4	29.5	9.2
	1	19.3	22.1	9.4	29.0	8.87
	2	19.1	19.0	9.1	27.2	8.26
	3	19.0	19.8	9.2	27.3	8.36
	4	19.0	19.3	9.3	26.7	8.25
	5	19.3	19.5	9.1	26.4	8.25
	6	19.2	19.4	9.0	25.8	8.15
	7	19.0	19.2	9.0	25.8	8.11
	8	19.0	19.1	9.0	25.6	8.08

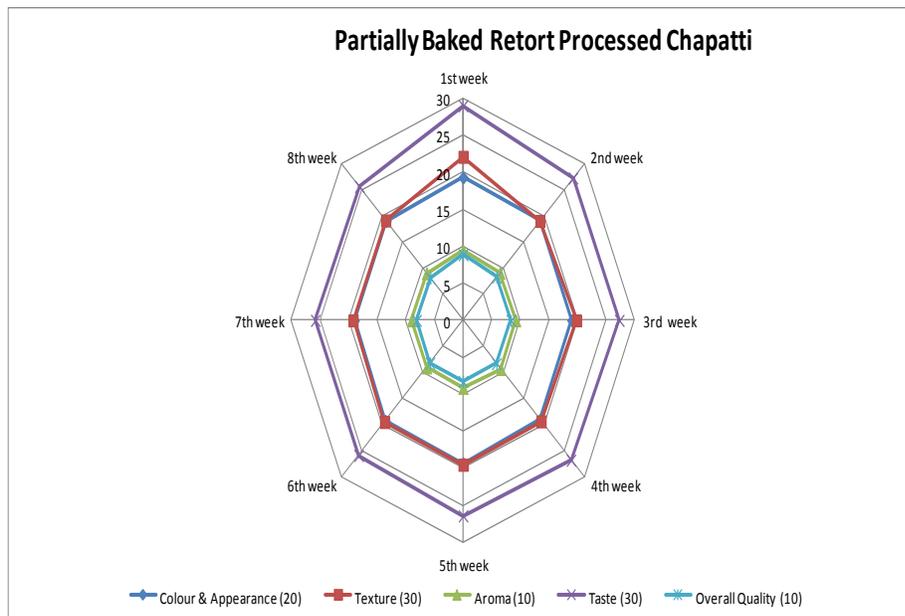


Fig.6 Sensory profile of Retort Processed Partially Baked Chapatti

CONCLUSION

- It is evident from the study that there is a considerable potential for thermal processing for the extended shelf life of partially baked chapatti.
- The chapattis thermally processed at F_{70} value for 10 min indicated that 4.5 min is the minimum time required for processing partially baked chapatti to attain commercial sterility.
- Retort processing at desired time and temperature showed microbiologically stable products with good sensory properties with a shelf life of about 8 weeks.
- The product remained highly stable and highly acceptable even after storage of 8 weeks under ambient conditions.
- Hence, the developed retort pouch processed partially baked chapattis can be preserved for long term storage, increasing their commercial scope and viability.

Thus, the study clearly indicates that a pre-designed level of thermal processing in combination with packaging could extend the shelf-life of retort processed partially baked chapatti upto 8 weeks.

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