

Original Research Article

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## Shelf-Life of Ready-To-Eat Retort Processed Pepper Chicken

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### ABSTRACT

#### Keywords

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The study was undertaken to standardize a shelf-stable ready-to-eat pepper chicken using broiler meat by retort pouch processing. Three experiments were conducted, in the first experiment the recipe was standardized (pilot scale study) on the basis of sensory evaluation and in second experiment retort pouch processing temperature (F<sub>0</sub> value) was determined based on references, commercial sterility test, visual observation, sensory evaluation and preliminary trials. The come up percentage was 27.27 and the F<sub>0</sub> value was 7.2 minutes. In third experiment, shelf stability was assessed for a period of 90 days by microbiological, physico-chemical and sensory qualities by repeating the trials for six times. Results of the present study revealed that the pepper chicken from broiler meat was biochemically and microbially safe for the entire storage period.

### Introduction

Ready-to-eat foods or products had been found to be microbiologically safe and organoleptically acceptable for a period ranging from three months to one year. The advent of modern urban dynamic lifestyle has created a demand for ready-to-eat food. The urban middle and upper middle class consumers have little time to do their cooking in a conventional manner and welcome ready to eat food products. Though such products are specially meant for consumption by the Armed Forces personnel during combat and special missions, they are also being

consumed by participants of rowing, mountaineering expedition, motor rallies and during Antarctica expeditions. Moreover, urbanization has generated a considerable interest among civil population in such types of processed foods (Rajkumar *et al.*, 2010).

Because of their strength, flexibility, and light weight, retort pouches have become a widely used alternative to traditional canning methods for preserving food and allowing it to stay fresh for many years. These pouches use less than 5% of the packaging material of traditional rigid tin cans and help improve food quality, texture, flavor, and aroma.

Thermal processing, i.e. heating, was one of the most important operations in food processing mostly used for pasteurization preservation, such as in canneries and pasteurization. In processing of food such as meats and vegetables, heat also acts to develop taste and flavor, and in addition to lower the microbial load in order to carry out physical changes to the food (Miri *et al.*, 2008).

Thermally processed foods were in wide range and a variety of containers were used as packaging material. The processing techniques also differ from product to product and from package to package. Hence the retort designs and operating procedures also vary (Satish *et al.*, 2005).

Advantages such as shelf-stability, less weight, less storage space, ease of opening and preparation and technical and commercial feasibility of using retortable pouches for the thermo-processed foods (Hu *et al.*, 1995).

Traditional or ethnic dishes are important due to their delicacy and these products have great demand but are rarely commercialized due to their short shelf life and can be preserved either in the frozen or ready-to-eat forms (Bindu *et al.*, 2010).

### **Materials and Methods**

Deboned meat of broiler was bought from the local market and washed with portable water. Indigenously manufactured retort pouches (Pradeep Laminators, Pune) having four layer configurations (from inside 1. Cast polypropylene, 2. Biaxially oriented nylon, 3. Aluminium foil and 4. Polyethylene) were used for the study.

Formulation of recipe was standardized based on the information collected from the famous chef, preliminary study (pilot scale) and sensory evaluation.

### **Preparation of pepper chicken gravy**

Pepper chicken gravy (Ingredients as per Table 1) was prepared separately by frying cinnamon, cloves, mace, lichens and poppy seeds in refined sunflower oil and then sliced onion was added and fried till it reached golden yellow colour. The sliced tomato was added and heated till all the water evaporated. Then freshly prepared ginger and garlic paste was added and sauted for 2 minutes, black pepper powder was added and sauted for 1 minute and then cashew nut paste and portable water was added and then cooked for 5 minutes. Finally cow's milk was added and mildly heated for 5 minutes. After processing all the pouches were wiped dry and kept in a dust proof cabinet at ambient temperature (25-30°C).

### **F<sub>0</sub> value**

Retort processing temperature was determined based on the values obtained from the experiment conducted with laboratory model overpressure autoclave/retort. Laboratory model was supplied by M/s Lakshmi Engineering having a capacity of 25 pouches. Sealed pouches were subjected to thermal processing by maintaining the retort temperature at 121.1°C. Pressure was maintained at 20 psi throughout the process by using steam-air mixture during heating and water-air mixture during cooling. The product core temperature and the lethal rates (F<sub>0</sub> value) were noted and the F<sub>0</sub> value was calculated by the following formula (Stumbo, 1973).

$$\text{Lethal rates/ } F_0 \text{ value (min)} = \log_{10}^{-1} \frac{(PCT-121.1)}{10}$$

Where PCT= Product Core Temperature

Product core temperature was noted for every minute till the product was processed and the

$F_0$  value was calculated by adding all the lethal rates noted every minute.

### **Storage studies**

#### **Commercial sterility test**

The commercial sterility study was done according to the Bureau of Indian Standards, 1971.

#### **Sensory evaluation**

Sensory evaluation was assessed by subjecting the samples to sensory scores of appearance, flavor, juiciness, tenderness and overall acceptability by a trained and semi-trained taste panel, by a 9-point hedonic scale.

#### **Microbial analysis**

Total viable count, anaerobic, *coliform*, *staphylococcal*, *clostridial* and yeast and mould counts of processed samples were determined by the method described by American Public Health Association, 1984 using media from Hi-Media, Mumbai.

#### **Physico-chemical parameters**

##### **pH, thio-barbituric acid number and tyrosine value**

pH was measured by using a digital pH meter (Cyberscan pH 510, Merck).

Thio-barbituric acid number (TBA) and tyrosine value (TV) was determined by the procedure outlined by Strange *et al.*, (1977).

##### **Hunter colour**

Colour of the sample were tested using Hunter lab Mini scan XE plus Spectro-colorimeter (Model No. 45/O-L, Reston Virginia, USA) with geometry of diffuse/80 (sphere – 8mm

view) and an illuminant of D65/10 deg (Bindu *et al.*, 2007).

### **Texture profile analysis**

Texture profile analysis was conducted using a Stable Microsystems Texturometer (Stable system Ltd., England, UK) model TA\_HD plus texture analyser attached to software, texture expert and analyzed as per Bourne, 1978.

#### **Statistical analysis**

The data obtained were analyzed statistically in SPSS software (version 20.0) according to Snedocor and Cochran (1994).

### **Results and Discussion**

The retort temperature and the product core temperature before processing were 35<sup>0</sup>C and 40<sup>0</sup>C respectively.

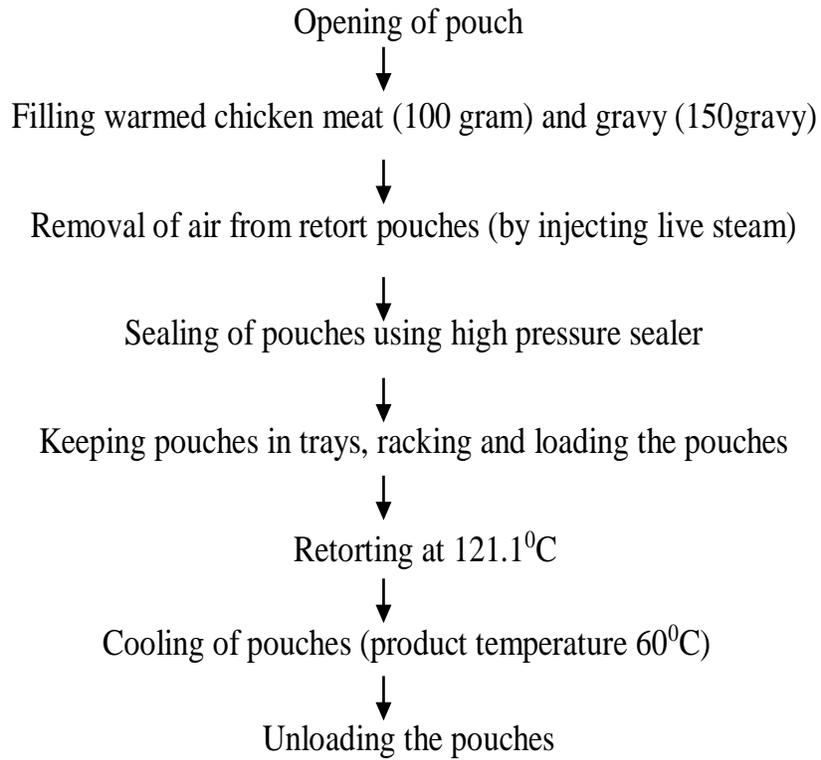
The product core temperature reached its first lethality rate of 0.001, when the product core temperature was 86.9<sup>0</sup>C (Devadasan, 2004; Sreenath *et al.*, 2017; Rajkumar *et al.*, 2010).

To reach the first lethality, come up time (CUT) 17 minutes which was below the CUT value (Rajkumar *et al.*, 2010) and the total lethality ( $F_0$ ) received for pepper chicken was 7.2 (graph 1).

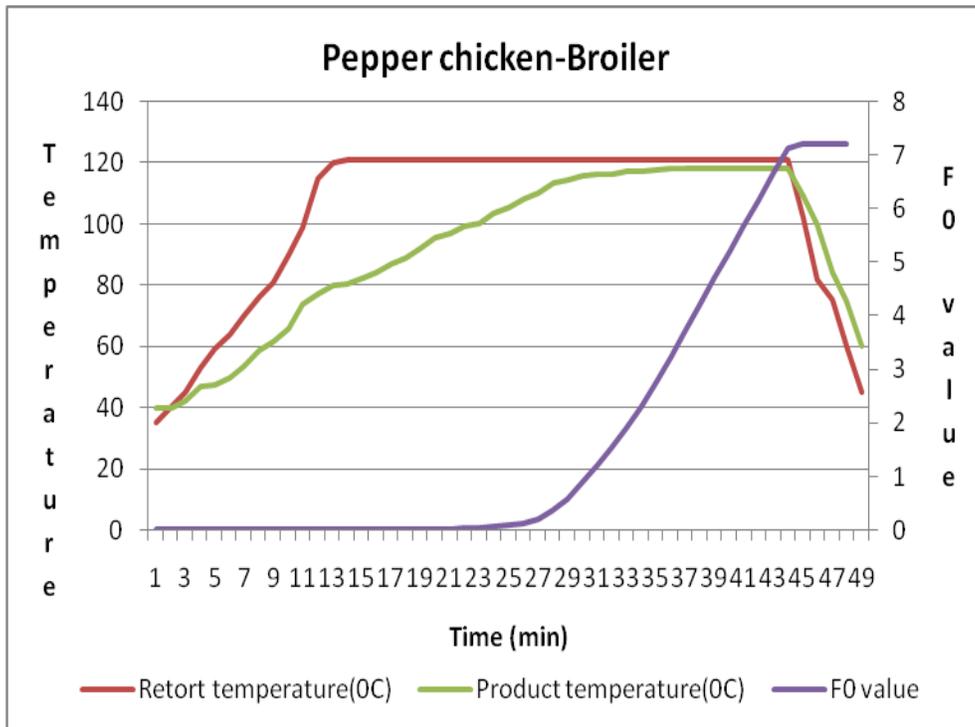
In commercial sterility test no tubes developed turbidity so the products were ‘commercially sterile’.

Sensory scores (Table 2) decreased highly significantly in appearance, flavour, juiciness and tenderness and are in acceptable limits up to 90days of storage. The results are similar to the study made by Gopal *et al.*, (2001), Shankar *et al.*, (2002), Chandrasekar *et al.*, (2004) and Bindu *et al.*, (2007).

**Flow chart for retort processing of pepper chicken**



**Graph.1** Standardized Retort processing data (Fo value)



**Table.1** Ingredient

S. No.	Ingredients		
		Wt. in grams	Percentage
1.	Onion	40.00	11.80
2.	Tomato	24.00	07.08
3.	Ginger	04.00	01.18
4.	Garlic	04.00	01.18
5.	Curry leaves	00.60	00.16
6.	Coriander leaves	00.60	00.16
7.	Onion leaves	00.60	00.16
8.	Red chilli powder	01.00	00.29
9.	Coriander seed powder	04.00	01.18
10.	Black pepper powder	05.00	01.47
11.	Cinnamon	00.20	00.06
12.	Mace	00.30	00.09
13.	Poppy seeds	00.20	00.06
14.	Cloves	00.30	00.09

**Table.2** Sensory evaluation score

Sensory score	Storage period (in days)					
	0	15	30	60	90	F value
Appearance	7.90 <sup>b</sup> ±0.07	7.87 <sup>b</sup> ±0.10	7.78 <sup>ab</sup> ±0.10	7.67 <sup>ab</sup> ±0.09	7.57 <sup>a</sup> ±0.08	2.49 <sup>NS</sup>
Flavour	7.78 <sup>c</sup> ±0.08	7.43 <sup>a</sup> ±0.08	7.70 <sup>bc</sup> ±0.09	7.60 <sup>abc</sup> ±0.07	7.50 <sup>ab</sup> ±0.08	3.17 <sup>NS</sup>
Juiciness	7.83 <sup>b</sup> ±0.13	7.68 <sup>ab</sup> ±0.11	7.73 <sup>ab</sup> ±0.13	7.63 <sup>ab</sup> ±0.11	7.43 <sup>a</sup> ±0.11	1.57 <sup>NS</sup>
Tenderness	7.71±0.08	7.42±0.29	7.62±0.09	7.60±0.09	7.52±0.06	0.63 <sup>NS</sup>
Over all acceptability	7.97 <sup>b</sup> ±0.04	7.82 <sup>ab</sup> ±0.09	7.93 <sup>b</sup> ±0.04	7.68 <sup>a</sup> ±0.08	7.82 <sup>ab</sup> ±0.05	2.99 <sup>**</sup>

**Table.3** Microbial count of pepper chicken

Microbial count	Storage period (in days)					
	0	15	30	60	90	F value
Total viable count	0.45 <sup>a</sup> ±0.02	0.51 <sup>a</sup> ±0.02	0.50 <sup>a</sup> ±0.01	0.48 <sup>b</sup> ±0.02	0.47 <sup>c</sup> ±0.02	24.09 <sup>**</sup>
Anaerobic count	ND	ND	ND	ND	ND	-
Staphylococcal count	ND	ND	ND	ND	ND	-
Coliform count	ND	ND	ND	ND	ND	-
Yeast and mould count	ND	ND	ND	ND	ND	-
Clostridium count	ND	ND	ND	ND	ND	-
Salmonella count	ND	ND	ND	ND	ND	-

**Table.4** Physico-chemical characteristics

Storage period (in days)	pH	TBA	TV
0	5.40 <sup>c</sup> ±0.02	0.45 <sup>a</sup> ±0.00	6.04 <sup>a</sup> ±0.03
15	5.38 <sup>bc</sup> ±0.02	0.51 <sup>a</sup> ±0.00	6.26 <sup>b</sup> ±0.06
30	5.36 <sup>abc</sup> ±0.01	0.50 <sup>c</sup> ± 0.00	6.38 <sup>c</sup> ±0.06
60	5.33 <sup>ab</sup> ±0.02	0.48 <sup>b</sup> ±0.00	6.73 <sup>d</sup> ±0.08
90	5.31 <sup>a</sup> ±0.01	0.47 <sup>b</sup> ±0.00	6.93 <sup>e</sup> ±0.05
F value	5.45 <sup>**</sup>	52.80 <sup>**</sup>	222.62 <sup>**</sup>

**Table.5** Hunter colour scores

Hunter colour scores	Storage period (in days)		
	0	90	F value
Lightness (L)	48.83±0.23	48.86±0.35	0.00 <sup>NS</sup>
Redness (a*)	13.60±0.52	11.82±0.17	10.41 <sup>**</sup>
Yellowness (b*)	34.10±0.27	31.55±0.25	47.44 <sup>**</sup>
Hue	68.28±0.74	69.47±0.41	1.97 <sup>NS</sup>
Chroma	36.73±0.09	33.70±0.30	58.83 <sup>**</sup>

**Table.6** Effect of storage on texture profile

Texture profile	Storage period (in days)		
	0	90	F value
Hardness 1(kgf)	16.05±0.14	59.21±0.58	5.29 <sup>**</sup>
Hardness 2(kgf)	15.08±0.073	52.50±0.51	5.30 <sup>**</sup>
Cohesiveness	0.35±0.01	0.43±0.01	24.76 <sup>**</sup>
Springiness(mm)	0.34±0.01	0.43±0.00	109.33 <sup>**</sup>
Chewiness (kgf/mm)	9.51±0.05	1.59±0.05	12.94 <sup>**</sup>

n = 6 observations

\*\* - highly significant (P<0.01) difference

\* - significant (P<0.05) difference

NS - No significant (P≥0.05) difference

ND – Not Detected

Microbial study (Table 3) reveals, anaerobic, *staphylococcal*, *coliform*, *Clostridium*, *Salmonella* and yeast and mould were absent on '0' day and the total viable count was 0.45±0.02 which increased significantly on 90<sup>th</sup> day to 0.47±0.02 log cfu. Total viable count at 35°C should be less than 10<sup>7</sup> per gram and that *Salmonella* should be detected

in not less than one of five, 25g samples of meat (ICMSF, 1974). Bacterial numbers of 3.0 log<sub>10</sub> colony forming units (cfu)/cm<sup>2</sup> may be regarded as indication of good hygiene or of an efficient commercial operation (Shankar *et al.*, 2002). So the products are microbially safe for consumption up to 90days of storage.

Physico chemical parameters (pH, TBA, TV) are presented in Table 4. The pH was  $5.40 \pm 0.02$ , indicating that it is towards the acidic side. The acidic nature of the product can be attributed by the curry ingredients like tomato. During storage, the pH of the products was found to exhibit a decreasing trend and it was  $5.31 \pm 0.01$  on 90<sup>th</sup> day which are significantly lower as compared to initial values (Sreenath *et al.*, 2007).

The TBA value on '0' day was  $0.45 \pm 0.00$  and on 90<sup>th</sup> day TBA number decreased to  $0.47 \pm 0.00$  which agrees with retort processed shrimp and squid masala (Sreenath *et al.*, 2007; Park *et al.*, 1993; Aubourg *et al.*, 1995).

The tyrosine values on '0' day was  $6.04 \pm 0.03$  and on 90<sup>th</sup> day of storage the tyrosine values increased significantly to  $6.93 \pm 0.05$ . This in accordance with retort processed Chettinad chicken from spent hen and broiler meat and assessment of storage stability at room temperature (Rajan, 2009).

Hunter colour scores are presented in Table 5. Pepper chicken made from broiler meat had an initial L value of  $48.83 \pm 0.23$  which reduced significantly to  $48.86 \pm 0.35$  on 90<sup>th</sup> day. Redness  $a^*$  of the product was found to decrease slightly with storage and was  $11.82 \pm 0.17$  at the end of storage study. The yellowness  $b^*$  value on '0' day was  $34.10 \pm 0.27$  which on storage changed significantly. Hue value on '0' day was  $69.47 \pm 0.41$ . Hue value did not change significantly during storage. Chroma (colour intensity) value on '0' day was  $36.73 \pm 0.09$ . At the end of 90<sup>th</sup> day chroma  $33.70 \pm 0.30$  which decreased highly significantly, this is in accordance with the in retort processed Chettinad style goat meat (Rajkumar *et al.*, 2010).

Texture is one of the important quality attribute affecting the consumer acceptability

of a food product. The analysis of texture (Table 6) becomes even more important in case of canned products which are intended for long periods of storage as storage period is one of the determinants in texture (Ahmed *et al.*, 1972) Hardness 1 and 2 for on '0' day were  $16.05 \pm 0.14$  and  $15.08 \pm 0.073$  kgf, respectively and on 90<sup>th</sup> day the hardness 1 and 2 values increased  $59.21 \pm 0.58$  and  $52.50 \pm 0.51073$  kgf, respectively. The results are similar to the retort processed Chettinad chicken meat and retort processed Chettinad style goat meat (Rajkumar *et al.*, 2010; Selvin, 2010). Hardness is mainly due to retort processing which causes conversion of collagen to gelatin and dissociation of muscle protein of goat meat. The springiness values on 0 and 90<sup>th</sup> day was  $0.39 \pm 0.02$  and  $0.45 \pm 0.00$  which changed significantly during storage at room temperature. The cohesiveness and chewiness on '0' day was  $0.37 \pm 0.02$  and  $3.01 \pm 0.42$  and on 90<sup>th</sup> day of storage was  $0.45 \pm 0.01$  and  $6.52 \pm 0.98$  respectively which increased highly significantly during the storage period.

Retort processed pepper chicken can be safely stored up to 90 days at room temperature without changes in its nutritive and sensory quality. The cost of production was in the affordable range of Rs.50 per pouch (250g). Hence it is felt that the retort processing technique can be useful in popularizing traditional products like pepper chicken and making it available to different places of the country as well as all over the world as heritage south Indian products of Indian origin.

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