

## Development and evaluation of shelf stable retort processed ready-to-drink (RTD) traditional Thari Kanchi payasam in flexible retort pouches

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### Article history

Received: 2 January 2013

Received in revised form:

7 March 2013

Accepted: 19 March 2013

### Keywords

Retort processing

Ready-to-drink

Thari kanchi payasam

Free fatty acid

F<sub>0</sub> value

### Abstract

Thari kanchi payasam is an Indian delicacy was prepared as per traditional method. It is a light sweetened hot drink made from milk with very little semolina and seasoned with nuts and raisins consumed during Ramzan fasting period. The Ready - to - drink (RTD) packed in four layer retort pouches and processed in a steam-air retort with overriding pressure. Time – temperature data was collected during heat processing using and heat penetration characteristics were determined. The total process time (TB) was 35 min with a F<sub>0</sub> value of 3.64. The product was evaluated for its shelf stability under ambient (27-30°C) and elevated (45°C) conditions for a period of 12 months. On storage, changes in moisture, total fat, protein, free fatty acid (FFA), and Peroxide value (PV) were determined at every 3 month intervals. Moisture and protein content of the product did not show any significant changes and the total fat content was found to decrease during storage. FFA was found to increase.  $1.92 \pm 0.01$ ,  $2.75 \pm 0.01$  at ambient and elevated temperature respectively, from an initial value of  $0.281 \pm 0.001$ . Microbiological analysis revealed that product was commercially sterile and fit for consumption. The samples were rated excellent by the taste panel and remained in good condition even after storage period.

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### Introduction

Thari kanchi payasam is a traditional Kerala product of India. It is a light sweetened hot drink made from milk with very little semolina and seasoned with nuts and raisins. Traditionally had while breaking the Ramzan fasting in the evening. It also eases the cramps that arise from the sudden rush of food after a day of abstinence from any food and water. Semolina (also known as Farina here) is known to be easily digestible.

Payasam, a traditional sweet delicacy has many varieties with distinct characteristics attributed to the area specific traditional method of preparation and ingredients used (Unnikrishnan *et al.*, 2000). The thari kanchi is prepared by using sooji, water, milk and sugar.

In both the developed and developing countries there is a growth in the demand for convenient ready-to-eat food products or ready to drink products. There is an increasing consumer demand for high quality convenient ready-to-drink food products and has led to an increase in the commercial production of ready-to-drink products (Kamatt *et al.*, 2005; Karadag and Gunes, 2008). This special category of food has been

defined as a catering system on the partial cooking of food followed by thermal processing under elevated temperature, storage in ambient condition and subsequent through re-heating before consumption. Such foods cover a wide range of items includes vegetarian and non-vegetarian foods. Retort (thermal) processing is intended to kill micro organism in food products to extend the shelf stability of the product, by the application of extreme heat condition (121.1°C). However, exposure of food to that condition may result in loss of nutritional and sensory qualities (Chiralt *et al.*, 2001). Thermal process design is adopted to maximize microbial inactivation with minimal collateral degradation to product quality (Gould, 1995). The other methods to minimize the quality degradation are combination of hurdles such as temperature (high or low), water activity, redox potential, preservatives and irradiation, which ensure stability, microbial safety and sensory quality of food (Leistner, 2000).

Retort pouch processing technology has been widely recognized as one of the alternatives to metal cans for producing thermally processed shelf stable foods (Sabapathy *et al.*, 2001). The retortable pouch is a flexible laminated pouch that can withstand thermal

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processing temperatures and combine the advantages of the metal can and plastic packages. Flexible retortable pouches are a unique alternative packaging method for sterile shelf stable products (Sabapathy and Bawa, 2003). The retort pouch has many advantages over canned and frozen food packages for both the customers as well as food manufactures. The advantages are pouch profile, storage and preparation efficiency, savings in transportation, package cost, improved flavour and savings of energy (Kumar *et al.*, 2007). Therefore, in this study an attempt has been made to develop shelf-stable ready-to-drink thari kanchi payasam using retort pouch processing technique as well as to evaluate the changes in quality attributes during storage.

## Materials and Methods

### Raw materials

Milk was purchased from local dairy. Good quality Small size semolina, Sugar, Salt, Ghee, Cashew nuts, Raisins, Cardamom are purchased from Local Market.

### Traditional method of preparation

The ingredients used for the preparations are given in Table 1. In a saucepan, added semolina, sugar, salt and milk, stirred well, kept it on a medium flame with stirring continuously and brought to boiling, kept it simmering for 5 minutes until semolina was cooked well and when the mixture was slightly thick, kept it aside. Ghee was heated in a separate vessel, added cashews and fried them until they turn brown. Raisins were added, removed this tempered oil and added it to the above thari kanchi payasam and stirred well.

### Packaging material

Pre-fabricated multilayer laminated retortable pouches consisting of 12 µm Polyester / 15 µm Nylon / 9 µm Aluminium foil / 80 µm Cast. Polypropylene (Total thickness 116 µm), 300 g capacity with a dimension of 15 X 20 cm were used to fill the product.

### Filling and sealing

Filling exactly 200 g of the product, the head space air was entrapped manually out before sealing the top of the pouch hermetically by an impulse heat sealer.

### Thermal processing of Thari Kanchi

A pilot-scale 250 kg capacity steam-air retorting system (M/s. Alpha steritech, Bangalore, India) was used for the experiment. Constructed of mild steel, the retort could withstand a working pressure

Table 1. Ingredients for Traditional Thari Kanchi

Semolina	750gm
Sugar	1.5 Kg
Milk	3 Litre
Ghee	100 ml
Cashews	50 g
Raisins	50 g
Cardamom	10g
Salt	To taste

of 3.5 bar. The retort is equipped with facility for using compressed air for overhead pressure and high pressure water cooling facility under pressure. The temperature was set at 121.1°C with a steam pressure of 1.03 bar and an overpressure of 1.37 bar was maintained during each process cycle. The retort had a programmable logic controller assisted manual control i.e. retort operation performed manually but with the help of discrete electronic programmable input detector controllers for temperature and pressure.

For heat penetration studies pouches were fixed with thermocouple glands through which thermocouples were inserted. Thermocouple output was measured using an Ellab CTF 9008 data recorder (Ellab A/S, Roedovre, Denmark). The tips of the thermocouples were inserted into the clam pieces for recording the core temperature during heat processing in a still over pressure retort. The retort temperature (RT) was maintained at 121.1°C and air pressure was maintained at 1.37 bar throughout the heating and cooling period. After processing the pouches to required  $F_0$  value, they were cooled rapidly to till the core temperature of the product reaches 55°C by pumping water into the retort and recirculating it. Total process time (TB) was calculated by the mathematical method of (Stumbo, 1973). The thermal processed pouches were tested for sterility.

### Physico-chemical analysis of the sample

Physico-Chemical of the sample was estimated according to AOAC (1995). Percentage of Free Fatty acid (FFA) expressed as oleic acid and Peroxide Value (PV) by the method of Rangana 1986.

### Storage

The Thari kanchi payasam is stored at different temperatures ambient temperature (27-30°C) and elevated temperature (45°C). The samples were analyzed periodically at 3 month interval for changes in sensory profile, microbiological parameters (Total Plate Count-TPC, Yeast and molds, Total Coliform Count and Spores Count) and chemical parameters (Moisture loss, Fat, Protein, Peroxide Value-PV, Free Fatty Acids-FFA, etc.).

### Microbiological analysis

The samples of processed thari kanchi payasam was analysed for their commercial sterility. The pouches were incubated at 37°C and 55°C for 7 days and 10 days respectively. TPC was determined using dextrose tryptone agar (DTA) after incubation for 48h at 30°C. Yeast and moulds were estimated with the help of acidified potato dextrose agar (PDA), after incubation at 30°C for 4-5 days. Spore formers were determined after killing the vegetative cells by keeping the samples in boiling water bath for 10 to 20 minutes and subsequent incubation at 37°C and 55°C for 48 h after incubation (Hanigan and McCance, 1976).

### Sensory evaluation

Sensory evaluation of the sample was conducted to assess the acceptability of the product by a panel of semi-trained panelists. The parameters considered were colour, taste, odour, texture and over all acceptability. The panelists used 9 point hedonic scale to rate the individual attributes numerically. Scores were assigned from 'like extremely' to 'dislike extremely' (Amerine *et al.*, 1965).

### Data analysis

All the analysis was carried out in duplicate. The data were analysed statistically to find out standard deviations and significance (Snedecor and Cochran, 1988).

## Results and Discussion

### Effect of retort processing on Thari kanchi Payasam

Thermal processing is mainly employed to inactivate microorganisms in foods to ensure microbial safety with minimum collateral degradation to product quality. For obtaining commercial sterility of the product thermal processing is essential. *Clostridium botulinum* is the heat resistance organism which will be destroyed retort processing.  $F_0$  value describes the time to reduce microbial population by a factor of  $10^{12}$ . A heating time of 3 minute at  $12^{10}$  reduces *Clostridium botulinum* population.

The purpose of heat penetration study is to determine the heating and cooling behavior of a product/package combinations in a specific retort system for the establishment of safe thermal process. Several factors like product conditions, packaging material and processing conditions can contribute to the variation in the time temperature data gathered.

The product was processed to  $F_0$  value of 3.646 and heat penetration characteristics are represented in Table 2. Retort come up time to reach 121°C was 10 min. This is sufficiently shorter as recommended

Table 2. Thermal processed parameters

Parameters	Values
Retort temperature	121°C
$F_0$	3.646
$T_B$	35 min

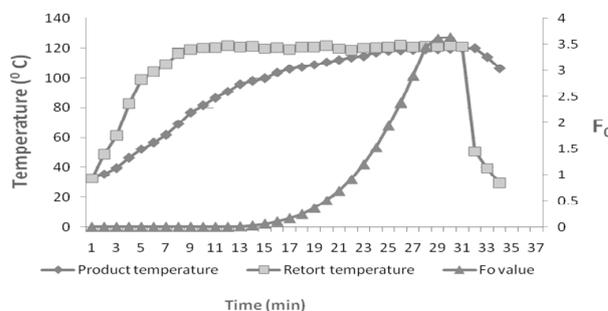


Figure 1. Heat penetration characteristics and  $F_0$  value

(NCA, 1968). The total process time ( $T_B$ ) was 35 minutes and a final  $F_0$  value of 3.646 was achieved, (Figure 1). After heat processing the pouches were cooled rapidly by circulating water. This sudden cooling prevents over cooking and also survival of thermophiles. The heat penetration characteristics in relation to  $F_0$  value is given in Figure 1.

The critical control points like raw and packaging material quality, product temperature, pouch sterilization, filling, temperature, weight, size, sealing, retorting, sanitation and storage conditions has to be kept in mind while preparing Thari kanchi payasam.

The Retort processed product was analyzed for its Physico-Chemical analysis like °Brix, pH, moisture content, fat and protein were  $15 \pm 0$ ,  $6.23 \pm 0.005$ ,  $79.47 \pm 0.497\%$ ,  $2.13 \pm 0.225\%$ , and  $1.96 \pm 0.015\%$  respectively. The FFA (Free Fatty acid) percentage and PV (Peroxide Value) were  $0.281 \pm 0.001$  and  $2.914 \pm 0.01$  and the same has been given in Table 3. The samples of the product stored under ambient and accelerated conditions were analyzed for the changes during storage.

The moisture content of the product did not show wide significant change. The packaging system based on aluminium foil has been reported to provide absolute barrier against mass transfer, light and microorganisms (Ghosh *et al.*, 1980) and the moisture content of the product was reduced by 2.19 and 3.25% in ambient temperature (27-30°C) and accelerated temperature (45°C) respectively. While the fat content of the product was found to be reduced upto 0.1% 0.23% at ambient temperature (27-30°C) and accelerated temperature (45°C) storage respectively. Protein content did not show any changes during storage in all conditions. Kumar *et al.*, 2007 also did not found wide variation in moisture and protein

Table 3. Physico-chemical analysis of Retort Processed Thari kanchi payasam during ambient (27-30°C) storage period

Storage (months)	0	3	6	9	12
<sup>0</sup> Brix	15 ± 0	15 ± 0	15 ± 0	15 ± 0	15 ± 0
pH	6.23 ± 0.005	6.23 ± 0.01	6.22 ± 0.01	6.22 ± 0.01	6.21 ± 0.01
Moisture (%)	79.47 ± 0.497	78.79 ± 0.11	78.63 ± 0.03	77.35 ± 0.05	77.28 ± 0.11
Fat (%)	2.13 ± 0.225	2.11 ± 0.22	2.09 ± 0.23	2.05 ± 0.22	2.03 ± 0.23
Protein (%)	1.96 ± 0.015	1.97 ± 0.01	1.97 ± 0.22	1.97 ± 0.02	1.97 ± 0.01
Peroxide Value (m.eq. of O <sub>2</sub> /kg fat)	2.91 ± 0.01	3.122 ± 0.001	3.626 ± 0.001	4.112 ± 0.001	4.81 ± 0.01
Free Fatty Acid (%)	0.281 ± 0.001	0.525 ± 0.006	1.123 ± 0.001	1.623 ± 0.001	1.92 ± 0.01

Mean ± SD of three determinations

Table 4. Physico-chemical analysis of Retort Processed Thari kanchi payasam during elevated (45°C) storage period

Storage (months)	0	3	6	9	12
<sup>0</sup> Brix	15 ± 0	15 ± 0	15 ± 0	15 ± 0	15 ± 0
pH	6.23 ± 0.005	6.23 ± 0.01	6.22 ± 0.01	6.22 ± 0.01	6.21 ± 0.01
Moisture (%)	79.47 ± 0.497	78.32 ± 0.12	77.67 ± 0.03	77.12 ± 0.04	76.22 ± 0.11
Fat (%)	2.13 ± 0.225	2.09 ± 0.22	2.01 ± 0.23	1.99 ± 0.22	1.90 ± 0.23
Protein (%)	1.96 ± 0.015	1.97 ± 0.01	1.97 ± 0.22	1.97 ± 0.02	1.97 ± 0.01
Peroxide Value (m.eq. of O <sub>2</sub> /kg fat)	2.91 ± 0.01	4.325 ± 0.001	6.862 ± 0.001	6.145 ± 0.001	7.01 ± 0.01
Free Fatty Acid (%)	0.281 ± 0.001	0.925 ± 0.006	1.832 ± 0.001	2.321 ± 0.001	2.75 ± 0.01

Mean ± SD of three determinations

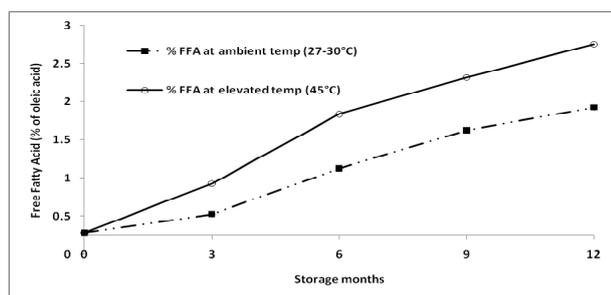


Figure 2. Changes in free fatty acid (FFA) content Thari kanchi payasam during storage

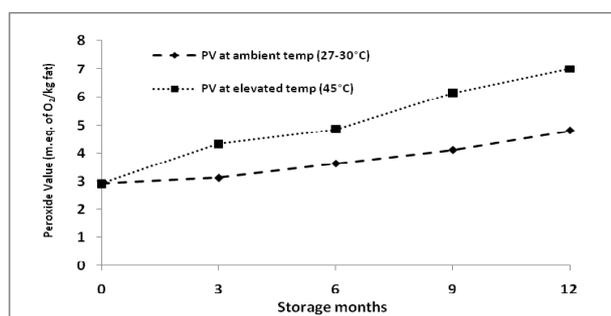


Figure 3. Changes in peroxide value (PV) content Thari kanchi payasam during storage

content but found decrease in fat content (Table 3, 4).

#### Changes in free fatty acid (FFA)

During storage of the product hydrolytic rancidity namely free fatty acids (FFA) increased upto 1.69% and 2.469 at ambient temperature (27-30°C) and

Table 5. Microbiological analysis Retort Processed Thari kanchi payasam

Processed Samples	TPC		Spores		Yeast & mold		Coliforms
	37 <sup>0</sup> C	55 <sup>0</sup> C	37 <sup>0</sup> C	55 <sup>0</sup> C	37 <sup>0</sup> C	55 <sup>0</sup> C	37 <sup>0</sup> C
After Processed	Nil						
3 month	Nil						
6 month	Nil						
9 month	Nil						
12 month	Nil						

Table 6. Sensory Evaluation of Retort Processed Thari kanchi payasam (\*9 point Hedonic Scale) n = 10

Storage Conditions	Storage Period (month)	Colour	Flavour	Taste	Texture	OAA
Ambient Temperature (27-30°C)	0	8.4 ± 0.42	7.9 ± 0.47	8.2 ± 0.52	8.1 ± 0.86	8.1 ± 0.87
	3	8.2 ± 0.74	7.9 ± 0.47	8.0 ± 0.92	7.9 ± 0.47	8.0 ± 0.92
	6	8.0 ± 0.92	7.8 ± 0.57	7.7 ± 0.83	7.5 ± 0.79	7.7 ± 0.86
	9	7.8 ± 0.42	7.4 ± 0.70	7.5 ± 0.71	7.9 ± 0.47	7.6 ± 0.52
Elevated Temperature (45°C)	12	7.4 ± 0.52	6.9 ± 0.57	7.4 ± 0.70	7.1 ± 0.70	7.1 ± 0.71
	3	8.0 ± 0.92	7.8 ± 0.57	7.7 ± 0.83	7.5 ± 0.79	7.7 ± 0.83
	6	7.5 ± 0.53	7.3 ± 0.74	7.4 ± 0.70	7.3 ± 0.83	7.3 ± 0.74
	9	7.4 ± 0.52	6.9 ± 0.57	7.4 ± 0.70	7.1 ± 0.70	7.1 ± 0.71
	12	6.9 ± 0.99	6.7 ± 0.83	7.3 ± 0.83	6.5 ± 0.65	6.6 ± 0.84

Mean ± SD of ten determinations

accelerated temperature (45°C) storage respectively (Table 3, 4). FFA which correlates the possibility of breakage of long chain fatty acid chain into individual fatty acid moieties (Figure 2). Aubourg *et al.* (1997) and Aubourg *et al.* (1990) have also observed that in the canning process increases in the FFA content. This is mainly due to the increased lipid hydrolysis at elevated temperature. Hence there is a gradual increase in FFA on storage.

#### Changes in peroxide value (PV)

Peroxide values (PV) measure the amount of peroxides contained in the fat. The formation of peroxide during storage is slow at first during an induction period, the length of which will depend on the nature of fat and the presence of antioxidant. The observation also confirmed that the peroxide value of the product not increased due to non-availability of oxygen, controlled by the packaging system (Figure 3). Peroxide value increased upto 4.81 ± 0.01 and 7.01 ± 0.01 at ambient temperature (27-30°C) and accelerated temperature (45°C) storage respectively from an initial value of 2.91 ± 0.01 (Table 3, 4). The increased in rancidity was in consonance with the decrease in fat content. The increase in PV was significant when compared to samples stored in ambient condition, clearly indicating that the rancidity formation was temperature dependent. Probably, the relative reduction in linolenic acid content of a fat during processing and storage in the presence

of moisture and heat is responsible to an increase in heterogeneous food products (Mc Clements and Decker, 2000). Kumar *et al.* (2007) and Agathian *et al.* (2009) also found little increase in peroxide value.

#### Microbiological analysis

The microbiological analysis showed that the product remained commercially sterile during the entire period of the storage and confirmed the adequacy of the processing as well as it's for consumption (Table 5). Kumar *et al.* (2007) and Agathian *et al.* (2009) also found commercially sterile during the entire period of the storage.

#### Sensory analysis

The Sensory analysis of Thari kanchi payasam using a 9-point hedonic scale revealed that initially the product scored  $8.4 \pm 0.42$  for color,  $7.9 \pm 0.47$  for flavor,  $8.2 \pm 0.52$  for taste,  $8.1 \pm 0.86$  for texture and  $8.1 \pm 0.87$  for Overall acceptability (Table 6). On storage, the sensory scores decreased both at ambient (27-30°C) as well as elevated conditions (45°C). Under ambient (27-30°C) conditions the sensory scores decreased upto  $7.4 \pm 0.52$  for color,  $6.9 \pm 0.57$  for flavor,  $7.4 \pm 0.70$  for taste,  $7.1 \pm 0.70$  for texture and  $7.1 \pm 0.71$  for Overall acceptability (Table 6). At elevated temperature (45°C), the decrease was from  $8.4 \pm 0.42$  to  $6.9 \pm 0.99$  for color,  $7.9 \pm 0.47$  to  $6.7 \pm 0.83$  for flavor,  $8.2 \pm 0.52$  to  $7.3 \pm 0.83$  for taste,  $8.1 \pm 0.86$  to  $6.5 \pm 0.657$  for textures and  $8.1 \pm 0.87$  to  $6.6 \pm 0.84$  for Overall acceptability (Table 6), and thus clearly indicating the effect of storage conditions on the quality attributes of the product. Then also samples stored both at ambient (27-30°C) as well as elevated conditions (45°C) were acceptable even after 12 months of storage as the Overall acceptability score of the product remained in good.

#### Conclusion

Development of retort pouch processed thari kanchi payasam has shown that traditional products like thari kanchi can be established as a shelf stable product besides increasing the commercial product. The overall acceptability score of the thari kanchi payasam remained in good during storage period, which would be commercially useful. The microbiological analyses revealed that the product remained commercially sterile during the entire storage at ambient (27-30°C) and elevated conditions (45°C) and hence the product was safe for consumption. The changes in peroxide value and free fatty acid content during storage did not affect the acceptability of the

product and well within the limits. In view of the acceptability of the product both in terms of physico-chemical and sensory properties, it could prove to be a means of value addition, product diversification and export promotion for traditional ethnic dishes.

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