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

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Abstract

Thari kanchi payasam is an Indian traditional 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 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 an Ellab data recorder cum F_0 integrator. The heat penetration characteristics were determined. The total process time (TB) was 35 min with a F_0 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 content, 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. FFA was found to increase 1.92 ± 0.01, 2.75 ± 0.01 at ambient and elevated temperature respectively, from an initial value of 0.281 ± 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

Introduction

Thari kanchi payasam is a traditional Kerala state 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).

Two different methods of conventional thermal processing are known aseptic processing, in which the food product is sterilized prior to packaging, and packing/canning in which the product is packed and then sterilized (Barbosa-Canovas *et al*., 1998). Food

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after being canned has to undergo thermal treatment to deactivate most organisms (i.e. sterilization). In 1981, the food industry in the United States alone processed more than 16.3 billion kg of food products in approximately 37 billion containers. Introduction of steam into the retort should be done with care since it is necessary to displace all of the air in the retort. The presence of air during thermal sterilization processing can result in under-processing since steam-air mixtures result in lower heat transfer rates (Karel *et al*., 1975). Still retorts are usually arranged either vertically or horizontally.

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 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. The main objective of this study is to development and evaluation of retort pouch processing of ready-to-drink thari kanchi payasam.

Materials and Methods

Raw materials

Milk was purchased from Nandini Milk booth, Siddartha Nagar, Mysore-India. Good quality Small size semolina, Sugar, Salt, Ghee, Cashew nuts, Raisins, Cardamom are purchased from the Mysore Local Market-India.

Traditional method of preparation

In a saucepan, add semolina, sugar, salt and thin milk, and stir well. Keep it on a medium flame with stirring continuously and bring to boil. Reduce the flame and keep it simmering for 5 minutes until semolina was cooked well and when the mixture was slightly thick, keep it aside. Heat a small vessel and add ghee. Add the cashews and fry them until they turn brown. Add raisins and let them puff up. Remove this tempered oil and add it to the above thari kanchi payasam and stir well.

Packaging material

Pre-fabricated multilayer laminated retortable pouches consisting of 12 µm Polyethylene terephthalate / 15µm Nylon /9µm Aluminium foil/ 80µm C.P.P (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 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 48 h 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

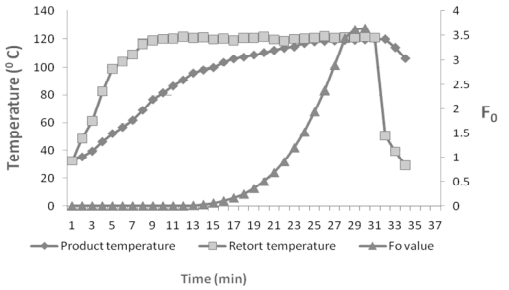

Figure 1. Heat penetration characteristics and F_0 value

describes the time to reduce microbial population by a factor of 10^{12}. A heating time of 3 minute at 1210 reduces *Clostridium botulinum* population.

The propose 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.

Retort come up time to reach 121°C was 10 min. This is sufficiently shorter as recommended (NCA. 1968). The total process time (TB) 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 thermopiles. 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±0, 6.23±0.005, 79.47±0.497%, 2.13±0.225%, and 1.96±0.015% respectively. The FFA (Free Fatty acid) percentage and PV (Peroxide Value) were 0.281±0.001 and 2.914±0.01 and the same has been given in Table 1. 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

Table 1. Physico-chemical analysis of retort processed Thari kanchi payasam during ambient (27-30°C) storage period

Storage (months)	0	3	6	9	12
^{0}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_2/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 2. Physico-chemical analysis of retort processed Thari kanchi payasam during elevated (45°C) storage period

Storage (months)	0	3	6	9	12
^{0}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_2/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

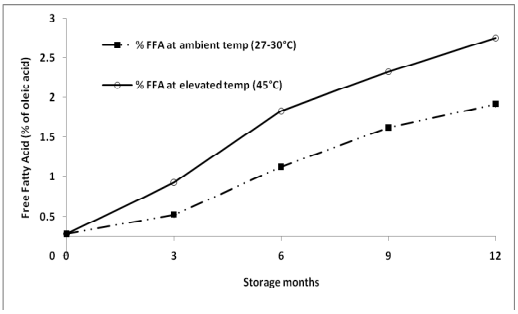

Figure 2. Changes in free fatty acid (FFA) content Thari kanchi payasam during storage

Table 3. Microbiological analysis retort processed Thari kanchi payasam

Processed Samples	TPC		Spores		Yeast & mold		Coliforms
	37^0 C	55^0 C	37^0 C	55^0 C	37^0 C	55^0 C	37^0 C
After Processed	Nil	Nil	Nil	Nil	Nil	Nil	Nil
3 month	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6 month	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9 month	Nil	Nil	Nil	Nil	Nil	Nil	Nil
12 month	Nil	Nil	Nil	Nil	Nil	Nil	Nil

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 content but he also found decrease in fat content (Table 1 and 2).

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 accelerated temperature (45°C) storage respectively (Table 1 and 2). FFA which correlates the possibility of breakage of long chain fatty acid chain into individual fatty acid moieties (Figure 2). Some authors (Aubourg *et al.*, 1990; Aubourg *et al.*, 1997) have also observed that the canning process increases the population of 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 1 and 2). The increased in rancidity was in consonance with the decrease in fat content. The increase in PV was significant when compare 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 its fitness for consumption (Table 3). Kumar *et al*. (2007) and Agathian *et al.* (2009) also found commercially

Table 4. 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^{0}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
	12	7.4 ± 0.52	6.9 ± 0.57	7.4 ± 0.70	7.1 ± 0.70	7.1 ± 0.71
Elevated Temperature (45^{0}C)	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

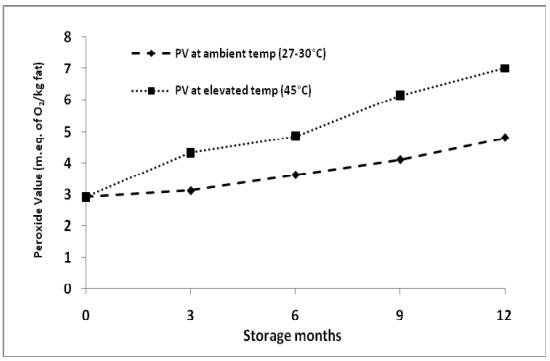

Figure 3. Changes in peroxide value (PV) content Thari kanchi payasam during storage

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±0.42 for color, 7.9±0.47 for flavor, 8.2±0.52 for taste, 8.1±0.86 for texture and 8.1±0.87 for Overall acceptability (Table 6). On storage, the sensory scores decreased both at ambient (27-30^{o}C) as well as elevated conditions (45^{o}C). Under ambient (27-30^{o}C) conditions the sensory scores decreased upto 7.4±0.52 for color, 6.9±0.57 for flavor, 7.4±0.70 for taste, 7.1±0.70 for texture and 7.1±0.71 for Overall acceptability (Table 6). At elevated temperature (45^{o}C), the decrease was from 8.4±0.42 to 6.9 ± 0.99 for color, 7.9±0.47 to 6.7±0.83 for flavor, 8.2±0.52 to 7.3±0.83 for taste, 8.1±0.86 to 6.5±0.657 for textures and 8.1±0.87 to 6.6±0.84 for Overall acceptability (Table 4), 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^{o}C) as well as elevated conditions (45^{o}C) were acceptable even after 12 months of storage as the Overall acceptability score of the product remained in good.

Conclusions

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. 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 period of storage at ambient (27-30^{o}C) and elevated conditions (45^{o}C) and hence the product was safe for consumption. 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 dairy and food industry.

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