

STANDARDIZATION OF READY-TO-DRINK (RTD) DAL PAYASAM WITH COCONUT MILK

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ABSTRACT

The present study aimed to develop and standardize RTD dal payasam prepared with coconut milk by replacing bovine milk by cooking dal (moong dal/ split yellow lentils) in coconut milk with added nuts, sugar and shredded coconut. The product was prepared with total solids of 22-23% as per commercial purpose. Three different trials (P1, P2 and P3) with varying quantities of dal (150g, 200g and 250g), jaggery (250g, 150g and 200g) and coconut milk of 200ml (based on preliminary study) was studied. The optimized dal payasam was filled in cans and retort processed at 121.1°C and overpressure of 1.29 bar with steam pressure of 1 bar. Lethality time (F_0) of 16.7 min and Total Process Time of 34.2 to 38.7 min was calculated by predictive thermal process modeling. Sensory evaluation of P1, P2 and P3 concluded that P3 with 250g moong dal, 200g jaggery, 200 ml coconut milk was highly preferred by sensory panelists. The finalized trial was further studied for its physico-chemical properties for 60 days at refrigerated ($4\pm 2^\circ\text{C}$) and room temperature ($25\pm 2^\circ\text{C}$). The study concluded that retort processed Ready-to-Drink dal payasam packed in cans was safe to consume upto 60 days of storage.

Keywords: Dal payasam, traditional dairy product, retort processing, coconut milk, F_0 value.

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INTRODUCTION

Payasam is a traditional cereal based milk dessert originated from Southern India, similar to Kheer in Northern States. The product is a semisolid liquid in state with basic

ingredients such as milk, pulses, lentils, millet or rice. Irrespective of its name, Payasam/ Kheer has been consumed for centuries as a cultural identity and heritage (Rangappa and Achaya, 1974). It is usually served hot at the end of meals or as a delicacy during festivals. Varieties of payasam are available based on the ingredients primarily used. A few examples are pal payasam, dal payasam,

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rice payasam, coconut water payasam, semiya payasam, etc. In this present study, dal payasam was prepared with coconut milk as an alternative to bovine milk by cooking dal (moong dal/ split yellow lentils) in coconut milk with added nuts, sugar and shredded coconut to improvise the consumption by vegans and lactose intolerant people. Dal payasam normally has a shelf-life of 2-3 days after reheating. Hence, retort processing of dal payasam would be beneficial to improve the shelf-life and for easier consumption. This product has been retort processed in cans and stored for 60 days. Physico-chemical and microbial analysis were carried out for 60 days. Retort processing was applied to a vast range of products from fruit juices to mutton kheema successfully with enhanced keeping quality without any compromise in taste and quality. Similarly, retorting of kheer has been studied by many authors such as Keogh (1970), Jha *et al.* (2011) and Gautam *et al.* (2014) who retorted rice kheer, long life kheer and chhana kheer respectively. The current study was only focused on standardization, physico-chemical and microbial analysis for the storage period of 60 days at refrigerated and ambient conditions.

MATERIALS AND METHODS

Moong dal (*Vigna radiata*), jaggery, ghee, coconut milk, cashew, raisins, shredded coconut flakes, cardamom and sugar were purchased from local market, Chennai. Cooking thermometer was used to record the temperature. Tin cans of dimensions 202 x 308 mm with total capacity of 170ml (6 ounce) as purchased from local dealer, Chennai.

The composition of ingredients used in three experimental trials of dal payasam (P1, P2 and P3) and payasam made with bovine milk was taken as control (C), tabulated in table 1. The product formulation was made in order to standardize the total solid content of 22-23% as per commercial purpose. The preparation procedure for dal payasam involves frying of moong dal at the temperature of $90 \pm 3^\circ \text{C}$ for 3 minutes until brown color and aromatic flavor develops. The fried dal was cooked at $110 \pm 3^\circ \text{C}$ for 5 minutes with added water (one liter). The slurry was mixed with jaggery (in syrup form and filtered to remove tiny stones) and cooked for about 3 minutes at $102 \pm 3^\circ \text{C}$. Coconut milk (light coconut milk TS per cent 12.1 was obtained by grinding and pressing of scraped coconut as per FSSAI, (2019) was added at the quantity of 200ml (this level was fixed based on preliminary trials). Simultaneously, cashew, raisins and shredded coconut flakes were fried in ghee and added to the dal payasam and mixed well. The hot mixture of dal payasam was packed in tin at the temperature of $90 \pm 2^\circ \text{C}$ and seamed.

Retort processing of dal payasam

A pilot-scale retort machine (M/s Lakshmi Works, Chennai) of 250 kg capacity with steam operating system was used for retorting the developed dal payasam. Thermocouple data recorder (M/s. HUATO-8 channel, USA) and water-cooling system were the parts of the retort processing. Operating temperature and pressure of 121.1°C and overpressure of 1.29 bar respectively with steam pressure of 1 bar and were set for each batch of products. The cans were loaded into the

machine and the thermocouple was inserted to record the internal core temperature. The cans were heated to core temperature of 121.1°C and the product was immediately cooled to 45°C by spraying water over the cans. After the completion of the process (F_0 value), the cans were unloaded and stored at $4\pm 2^\circ\text{C}$ and room temperature ($25\pm 2^\circ\text{C}$) for physico-chemical characterization during storage. Total process time (TPT) was calculated by predictive thermal process modeling (Stumbo, 1973; Friso, 2013).

Determination of lethality (F_0) time of retort processed dal payasam

The lethality/sterilization time and total process time were calculated by predictive thermal process modeling (Patashnik, 1953; Stumbo, 1973; Friso, 2013 and Ball, 1923). Lethality/sterilization time (F_0) in terms equivalent to retort temperature (121.1°C) was obtained.

Sensory analysis

Sensory panelists of 30 semi-trained panelists were selected for optimization of dal payasam among 6 trials with a control. 9-point hedonic scale was used to numerically assess the acceptability of developed Dal payasam.

Analytical methods

Physico-chemical, oxidative and microbial analysis were done according to AOAC(1995). The samples from optimized trials were analysed for the storage period upto 60 days at room temperature as well as at the refrigerated temperature at the interval of 10 days.

Statistical analysis

All the parameters were repeated in triplicate and subjected to One-way ANOVA and Tukey's Duncan test using IBM SPSS® (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Optimization of dal payasam using Sensory Evaluation

From table 2, compared to the control P1 had increased sweetness due to addition of 250g jaggery and produced brownish color which was less likely desired by sensory panelists. Due to less amount of jaggery added in P2, the sensory attribute for sweetness perceived below than acceptable level. In P3, the consistency was smooth and thicker due to added dal (250g) which provided rich texture, which was in equal proportion with coconut milk that further enhanced the silky body of payasam. Hence, by considering the overall acceptability, P3 was optimized that had better sensory attributes than other samples and further studied for physico-chemical analysis. Highly significant difference ($p<0.05$) was observed between the treatments during statistical analysis.

Similar sensory profile was observed by Barela and Shelke (2017) who developed kheer made with cow milk blended with coconut milk (80:20 ratio) and concluded that the kheer had a higher overall acceptability rate when compared to control. The results were also in accordance with Unni krishnan *et al.* (2000).

Determination of lethality (F_0) time of retort processed dal payasam

The heating process was primarily due to convection mode as payasam was a liquid product. Total process time can be broadly by simple relationship expressed by Thermal Engineering Research Group of American Can Company based on Bauer formula,

$$T_1 - \tau_2 - \tau_3 + P + t$$

where, T_1 heating time, τ_2 constant sterilization time, τ_3 cooling time, P back pressure usually 0.12 - 0.13 MPa and t sterilization temperature (Zhucheng, 2018). Based on this calculation, total process time ranged from 34.2 to 38.7 min and lethality/ sterilization time was 16.7 min (Table 3) which was further verified by the method of Patashnik, (1953).

The results were similar to long-life Kheer using retort processing in which total process time was 14.89 to 21.52 min. Low process time was due to the fact that retort pouches consume 5-6 per cent less time to complete the sterilization time than cans (Jha *et al.*, 2011). The product produced a prominent change in color and flavour due to caramelization of jaggery during sterilization.

Physio-chemical analysis of retort processed RTD dal payasam during storage ($4 \pm 2^\circ\text{C}$ and $25 \pm 2^\circ\text{C}$)

pH

Highly significant ($p < 0.05$) difference was observed between the storage days at both the storage conditions. pH reduced from 6.8 ± 0.1 to 6.4 ± 0.2 and 6.8 ± 0.02 to 5.8 ± 0.01

respectively during refrigerated and ambient storage. Long shelf life Kheer with added coconut milk and Nendran variety of banana had pH range of 6.0 to 6.1 (Rasane *et al.*, 2019). In the present study, the lower value of pH was due to the presence of pulses (Moong dal) which is acidic in nature.

Total Solids (TS)

No significant ($p > 0.05$) difference in TS per cent was observed between the storage days at refrigerated storage. Change in TS per cent was noted only on 50th day onwards, with negligible difference in ambient temperature storage. Significant difference ($p < 0.05$) in TS per cent may be due to moisture loss based on relative humidity and temperature in the surrounding environment (Chaim *et al.*, 1994). Hence, storing canned food products would be nutritionally beneficial if stored in refrigerated condition (Kramer, 1977). However, refrigeration of higher viscosity product may result in thickening and crystallization of jaggery particle that shows sandy texture on consumption.

Moisture

Insignificant difference in moisture content was observed at the end of storage period. This loss may be attributed due to adverse environmental conditions while in storage. Moisture loss also contributes to nutritional loss particularly vitamins. Refrigerated samples showed minimum moisture loss compared to ambient stored products (Abhishek *et al.*, 2014).

Fat

No significant difference ($p>0.05$) in fat content was observed at the end of storage period. At refrigerated temperature the change in fat content was noticeable from the 40th day while in ambient storage changes occurred from the 20th day. This shows that the fat content undergoes degradation in ambient storage. The fat content of coconut milk and moong dal was found to be 10.23 ± 0.34 and 1.3 ± 0.76 on analysis of raw material. The lesser value of developed dal payasam compared with control may be due to dilution with other ingredients during cooking. Similar products like rice kheer with Khamang rice had a fat content of 5.31% (Chavhan *et al.*, 2019). Higher content of fat% provided the product a smooth and rich body and texture that was highly desirable.

Total Protein

Appreciable changes in total protein content during storage days were not observed in present study. Similar phenomenon was enlightened by Mohammed Ali *et al.* (2013).

Free Fatty acid (FFA)

The changes in fat content contributed due to lipolysis of fatty acids present in coconut milk. Coconut milk contains higher levels of medium chain fatty acids (particularly lauric acid C12:0) which proves to have several health benefits such as lowering the risk of atherosclerosis and heart problems (Seow and Gwee, 1997; Belewu *et al.*, 2010). FFA

per cent tends to increase upon storage with significant difference and highly significant was observed when stored in refrigerated storage and ambient temperature respectively. Concomitant results were observed by Regula (2007) who also reported FFA increases especially at higher temperature on storage.

Peroxide Value (PV)

Peroxide value (PV) usually indicates primary oxidation rate of fat, in which fatty acid present in the products undergoes lipolysis and results in formation of hydroperoxide. The decrease in fat% and increase in FFA per cent clearly depicts the fat degradation process which in turn increased the PV on storage. From the table 4 and 5, it was well understood that PV was higher when the product was stored in ambient temperature, but the product was acceptable till the end of storage. Increase in PV on storage of long life Kheer was studied by Mohammed ali *et al.* (2013) and Agathian *et al.* (2009).

Microbial analysis of optimized dal payasam during storage

No growth of bacteria, yeast and mold were observed during microbial analysis for 60 days at the interval of 10 days in both refrigerated and ambient stored dal payasam. Since the product was retort processed, the cans remained commercially sterile till the end of the storage and consumable without any off-flavor or unacceptable sensory attributes. This proves the previous finding of retort processed coconut kheer by Kumar *et al.* (2007).

Table 1. Experimental Trials for Preparation of dal payasam

Ingredients	Control	Trial 1 (P1)	Trial 2 (P2)	Trial 3 (P3)
Moong Dal (g)	250	150	200	250
Jaggery (g)	250	250	150	200
Water (ml)	200	200	200	200
Milk (ml)	200	-	-	-
Coconut milk (ml)	-	200	200	200
Shredded coconut flakes (g)	10	10	10	10
Ghee (g)	10	10	10	10
Cashew (g)	10	10	10	10
Raisins (g)	10	10	10	10

Table 2. Sensory Score for Optimization of Processed Dal Payasam

Trials	Consistency	Colour and appearance	Flavour	Taste	Sweetness	Mouth feel	Overall acceptability
Control	8.66 ±0.076 ^b	8.75 ±0.193 ^a	8.23 ±0.209 ^a	8.58 ±0.168 ^a	8.77± 0.139 ^{bc}	8.08 ±0.239 ^a	8.07 ±0.165 ^a
T1	7.58 ±0.164 ^a	8.38 ±0.174 ^a	8.41 ±0.232 ^a	8.37 ±0.264 ^a	7.92± 0.263 ^a	8.02 ±0.322 ^a	8.17 ±0.238 ^a
T2	7.68 ±0.158 ^a	8.41 ±0.166 ^a	8.43 ±0.243 ^a	8.28 ±0.178 ^a	8.12± 0.174 ^{ab}	8.58 ±0.190 ^a	8.42 ±0.259 ^a
T3	8.53 ±0.154 ^b	8.23 ±0.229 ^a	8.72 ±0.130 ^a	8.67 ±0.169 ^a	8.83± 0.067 ^c	8.07 ±0.214 ^a	8.67 ±0.169 ^a
F value	15.525	1.288	0.918	0.818	6.905	1.161	1.616

*values are expressed as mean ±SE.

In each column, values with different superscript vary significantly (P< 0.05)

Table 3. Determination of lethality (F_0) time of thermal processing of dal payasam

Parameters	Values
Sterilization temperature	121.1°C
Lethality time (F_0)	16.7 min
Total Process Time	34.2 to 38.7 min

Table 4. Physico-Chemical changes in Retort Processed Dal Payasam at Refrigerated Storage ($4\pm 2^\circ\text{C}$)

Parameters	0 th day	10 th day	20 th day	30 th day	40 th day	50 th day	60 th day	F value
pH	6.8 ^c ±0.1	6.8 ^{dc} ±0.01	6.8 ^d ±0.01	6.8 ^d ±0.02	6.7 ^c ±0.1	6.6 ^b ±0.1	6.4 ^a ±0.2	136.11**
Total solids per cent	22.89 ±0.02	22.89 ±0.01	22.89 ±0.02	22.89 ±0.02	22.89 ±0.02	22.87 ±0.01	22.86 ±0.03	95.04 ^{NS}
Moisture per cent	74.56 ^a ±0.05	74.56 ^a ±0.04	74.55 ^{ab} ±0.06	74.55 ^b ±0.05	74.54 ^c ±0.04	74.54 ^c ±0.04	74.53 ^g ±0.05	32.78 ^{NS}
Fat per cent	10.12 ±0.00	10.12 ±0.00	10.12 ±0.00	10.12 ±0.02	10.10 ±0.01	10.08 ±0.00	10.08 ±0.01	2.00 ^{NS}
Total protein per cent	4.6 ±0.04	4.6 ±0.05	4.6 ±0.05	4.6 ±0.03	4.6 ±0.06	4.6 ±0.05	4.6 ±0.06	7.78 ^{NS}
Free fatty acids per cent	0.17 ^a ±0.008	0.17 ^a ±0.006	0.17 ^a ±0.007	0.19 ^b ±0.007	0.21 ^c ±0.005	0.24 ^d ±0.005	0.28 ^c ±0.006	945.33*
Peroxide value (equiv. O₂/meq/kg)	0.3 ^a ±0.003	0.3 ^a ±0.001	0.3 ^a ±0.002	0.5 ^b ±0.003	0.6 ^c ±0.001	0.7 ^d ±0.002	1.5 ^e ±0.003	354.61**

*values are expressed as mean ±SE.

In each row, values with different superscript vary significantly (P< 0.05)

Table 5. Physico-Chemical changes in Processed Dal Payasam at Ambient Storage (25±2°C)

Parameters	0 th day	10 th day	20 th day	30 th day	40 th day	50 th day	60 th day	F value
pH	6.8 ^f ±0.02	6.8 ^f ±0.02	6.6 ^c ±0.01	6.5 ^d ±0.01	6.3 ^c ±0.02	6.1 ^b ±0.01	5.8 ^a ±0.01	1873.11**
Total solids per cent	22.89 ^a ±0.02	22.89 ^a ±0.01	22.89 ^a ±0.02	22.87 ^a ±0.02	22.85 ^a ±0.02	22.82 ^a ±0.01	22.80 ^a ±0.03	734.62*
Moisture per cent	74.56 ^{dc} ±0.04	74.56 ^d ±0.04	74.55 ^d ±0.04	74.54 ^c ±0.05	74.54 ^c ±0.05	74.53 ^b ±0.04	74.51 ^a ±0.03	955.32**
Fat per cent	10.12 ±0.00	10.12 ±0.00	10.11 ±0.02	10.07 ±0.03	10.05 ±0.02	10.05 ±0.01	10.02 ±0.03	46.84 ^{NS}
Total protein per cent	4.6 ±0.05	4.6 ±0.05	4.6 ±0.05	4.6 ±0.04	4.6 ±0.06	4.6 ±0.06	4.6 ±0.05	24.93 ^{NS}
Free fatty acids per cent	0.17 ^a ±0.005	0.17 ^a ±0.003	0.19 ^b ±0.002	0.20 ^c ±0.002	0.23 ^d ±0.003	0.27 ^c ±0.005	0.30 ^f ±0.004	845.22**
Peroxide value (equiv. O₂/meq/kg)	0.3 ^a ±0.005	0.5 ^b ±0.003	0.7 ^c ±0.005	1.3 ^{dd} ±0.005	1.5 ^c ±0.004	1.7 ^{ff} ±0.005	2.1 ^g ±0.003	333.28**

*values are expressed as mean ±SE.

In each row, values with different superscript vary significantly (P< 0.05)

CONCLUSION

High shelf-life stable dairy products and sweet delicacies have been developed and studied by various processing techniques by many researchers. Developed retort processed RTD dal payasam prepared using coconut milk as alternative to bovine milk which will improvise the consumption of payasam by vegans and lactose intolerant people. This

commercially stable dal payasam can be stored till 60 days without any unacceptable sensory attributes. Study on fatty acid profile and accelerated storage studies further strengthen the product and enhance the quality for export purpose.

Conflict of interest

The authors declare no potential conflict of interest.

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