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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(9): 134-136

www.thepharmajournal.com
Received: 06-07-2019
Accepted: 10-08-2019

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Process optimization and shelf life study of retort processed coconut milk

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Abstract
A study was conducted to develop a sterilized coconut milk using retort for household consumption. In India so far coconut milk is not processed commercially. Tetra pack has done only in UHT technology which cost about minimum of Rs 15 crores. By retort processing technology, it can be made available in glass and polypropylene bottles which are cheaper and retort machine are available at minimum rate of Rs 2 lakhs onwards. Coconut milk was extracted using hydraulic press from fresh coconut gratings and diluted to a fat content of 20%. Proximate analysis and physic-chemical properties of processed coconut milk were analyzed. Studies have indicated that sterilization of coconut milk at 90 ˚C for 15 minutes can be stored in room temperature for four months without affecting its overall acceptability.

Keywords: Coconut milk, retort processing, proximate analysis, storage study

1. Introduction
Coconut (*Cocus nucifera*) is the stone of the drupes borne by the coconut palm, a member of monocotyledonous family Palmae. It is known as the wonder food and is regarded as perfect diet because it contains almost all essential nutrients needed by the human body. Indonesia, Philippines and India are the major producers and account for about 75% of world production (Sivapragasam, 2008) [13].

Coconut milk is the word used to present the liquid obtained by manual or mechanical force of coconut meat (Narataruksa, 2010) [10]. It is the white, oil-in-water emulsion extracted from fresh coconut flesh with or without added water. It is made with finely grated coconut meat that is steeped in hot water and then filtered. Coconut milk is becoming an increasingly important raw material in home cooking as well as in the food processing industries (Muda, 2002) [9]. It is estimated that 25% of the world coconut output is consumed as coconut milk (Gwee, 1997) [7]. It can also be used as a substitute for milk in some desserts such chocolate and other confection products are exotically flavoured with coconut milk (Muda, 2002) [9].

Coconut milk contains fat, water, carbohydrate, protein, and ash with the major components being water and fat (Tansakul and Chaisawang, 2006) [14]. Coconut milk contains about 54% moisture, 35% fat and 11% solid non-fat and they also showed that fat content played an important role in the flow property of coconut milk (Tansakul and Chaisawang, 2006) [14]. Coconut milk contains significant amounts of fat, but unlike other nuts, it provides fat that is mostly in the form of medium chain saturated fatty acids (MCFAs) that is abundant in mother's milk in particular, lauric acid (Baldioli, 1957) [3].

Retort processing is also known as pressure cooking or autoclave processing and is a common method for in-container sterilization of foods. The development of retorts has been towards use of a steam-air mixture for heating, instead of water or saturated steam. The pressure needed in the retort is approximately 10 psi above atmospheric pressure for sterilization at 116 °C, 15 psi at 121 °C and 20 psi at 127 °C (Potter and Hotchkiss, 1998) [11].

The advent of Ultra High Temperature (UHT) treatment of coconut milk has added a new dimension to marketing of liquid milk in urban areas as well as remote areas. But, the cost of equipment involved in the production of UHT treated coconut milk is very high. There is a need for an alternate technology affordable to small scale entrepreneurs in India to increase the farmer's income through value addition. Retort pouch processing is one method of thermal processing which can be used as an alternative method at lesser investment. The coconut milk with added stabilizers and emulsifiers are not being preferred by consumers and there is a high demand for processed coconut milk without any additives. In this perspective the present study has been carried out to optimize the process, to find out proximate and shelf life of the retort

processed coconut milk.

2. Materials and Methods

Matured fresh coconuts were obtained from the nearby local market. The packaging materials were procured from Lakshmi engineering, Ambattur, Chennai.

2.1 Processing of coconut milk

Initially matured fresh coconuts were de-husked and splitted manually. Split coconuts were washed thoroughly with potable water. The coconuts were shredded using coconut scrapper manually without brown testa. The shredded coconuts were steam blanched for 20 minutes at a temperature of 80 °C. The coconuts were removed and cooled to room temperature. The shredded coconut was taken in muslin cloth and placed in a perforated vessel where the coconut milk was collected after being pressed using hydraulic press without adding water. 70% of RO water was added to the extracted coconut milk to reduce fat content to 20% and the milk was heated to 70 °C using double jacketed kettle. Then the milk was homogenized for 15 minutes using a double stage homogenizer at pressure of 2500psi and 500psi. The Glass bottles were previously cleaned and sterilized at 80 °C for 20 minutes. The collected coconut milk was filled in 200ml glass and PP bottles then capping was done using crown corking machine. The bottles were placed in the retort and processing was carried out at four different combinations.

Control-Coconut milk without retort processing

Trial 1- Retort processing of coconut milk carried out at 121 ºC for 15mins.

Trial 2- Retort processing of coconut milk carried out at 110 ºC for 15mins.

Trial 3- Retort processing of coconut milk carried out at 100 ºC for 15mins.

Trial 4- Retort processing of coconut milk carried out at 90 ºC for 15mins.

2.2 Physico-chemical analysis

i) Determination of pH and titratable acidity

pH meter (SUSIMA Technologies Private Limited, Chennai) was used as described in AOAC (2005) [2]. For coconut milk, titratable acidity was determined as done in ISI Handbook, SP 18:1981.

2.3 Proximate composition

i) Moisture content

Moisture content was determined by the gravimetric method as described in AOAC (1990) [1].

ii) Estimation of Protein content

The protein content of the sample was determined by Kjeldahl method as described in AOAC (1990) [1] using Kjeltron protein analyser (Tulin equipment, Chennai). It consists of digestion unit with four heating slots and a digital distillation unit.

iii) Estimation of fat Content

The Fat content of coconut milk was determined gravimetrically by modified Rose-Gottlieb method as described in (BIS: SP: 18, Part XI, 1981) [6].

iv) Estimation of ash Content

Muffle furnace (Technico Laboratory Products, Chennai) was used to determine the ash content in the product as described in AOAC, 1990 [1]. It is fitted with thermostat digital temperature controller to set the temperature inside the furnace and electric coiled heater to produce heat.

v) Total solids

Total solids of coconut milk were determined by hot air oven method.

2.4 Sensory evaluation

Each panelist was served with a standard score card (‘9’ point hedonic scale) for recording score for sensory attributes such as colour and appearance, flavour, body and texture, and overall acceptability of the product. The trained judges were served with a 50 g of each sample. Every sample has given code number which was changed from trial to trial to hide the identity of the product**.** The Score card for sensory evaluation is made as per (IS: 6273 (Part –II), 1971) [8].

2.5 Statistic analysis

The results from all of the tests were calculated as mean ±SE obtained from average of six trials. Analyses were performed using IBM SPSS® 20.0 for Windows® software as per the standard procedure of Snedecor and Cochran, 1989 [12].

3. Results and Discussion

Optimization of retort processed coconut milk were done at different time – temperature combination viz., 90 ˚C for 15 minutes, 100 ˚C for 15 minutes, 110 ˚C for 15 minutes and 121 ˚C for minutes. In which the trial done at 90 ˚C for 15 minutes was found to be stable and not coagulated for the period of 4months at room temperature whereas other combination were coagulated during processing. So the trial with 90 ˚C for 15 minutes was taken for further studies.

pH and titratable acidity of retort processed coconut milk obtained shows the changes during storage (Table 1). The pH decreases from 6.28 ± 0.02 at 1st month to 6.22±0.03 at 4th month whereas, titratable acidity decreases from 0.277 ± 0.00 at initial month to 0.330 ± 0.002 at final month. According to Banzon and Velasco, 1982 the pH of fresh coconut milk was 5.9-6.3. The FFA content of fresh coconut kernel is 0.45-0.65% as lauric acid (Barlow, 2006) [4].

Coconut milk was analyzed for proximate composition. It contains moisture 74.80%, fat 20.14%, protein 2.83%, ash 0.63% and total solids 1.60%. The result of proximate composition agree with the findings of coconut handbook.

Sensory evaluation was carried out with different storage interval for retort processed coconut milk the results are given in table 2. Panelists were served for evaluation of sensory attributes. Though significant difference was found statistically but by the value there was no significant difference found till 4th month. On average the overall acceptability of coconut milk was 8.31.

4. Tables

Table 1: pH and titratable acidity

	Raw coconut milk	Retort processed coconut milk (in month)				F value
		1st	2nd	3rd	4th	
pH	6.3±0.01	6.28±0.02	6.25±0.00	6.24±0.01	6.22±0.003	0.42^{NS}
acidity	0.279±0.00	0.277±0.00	0.289±0.002	0.295±0.001	0.330±0.002	0.35^{NS}

Table 2: Sensory Evaluation

Sensory attributes	Raw Coconut milk	Retort processed coconut milk (in month)				F Value
		1st	2nd	3rd	4th	
Colour	8.86±0.04	8.51±0.16	8.46±0.07	8.38±0.22	8.25±0.24	2.35*
Flavour	8.78±0.29	8.49±0.15	8.39±0.24	8.35±0.04	8.23±007	1.79*
Taste	8.88±0.25	8.48±0.06	8.47±0.15	8.37±0.10	8.27±0.29	2.73*
Consistency	8.76±0.08	8.52±0.08	8.46±0.08	8.3±0.08	8.24±0.11	2.59*
Overall acceptability	8.9±0.04	8.51±0.24	8.41±0.20	8.34±0.08	8.23±0.12	2.18*

5. Conclusions

An attempt was made to increase the shelf life of the coconut milk by retort processing technology in glass and poly propylene bottles. Retort processing done at combination of 90 ˚C for 15 minutes can be stored up to 4 months at room temperature without affecting its overall acceptability. Physico-chemical properties and sensory attributes were almost same from the initial month to final month.

6. Acknowledgments

The authors acknowledge the help provided by the Department of Food Processing Technology and Department of Food Safety and Quality Assurance, College of Food and Dairy Technology and Department of Livestock Products Technology, Madras Veterinary College, TANUVAS for utilizing the lab facilities for analysis physical parameters and quality control analysis.

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