

A Comparative Study to Investigate the Changes of Sour Fish Curry Under Modified Atmosphere Packaging with Existing Packaging Methods

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Abstract—Sour fish curry, locally known as "Ambul Thiyal," is a traditional and popular dish in Sri Lanka, appreciated for its unique flavor and cultural significance. However, its short shelf life due to the perishable nature of fish and the risk of microbial spoilage restricts its availability and marketability. To address this issue, this research aims to store ambul thiyal in a Modified Atmosphere Packaging (MAP) system that can extend the shelf life of Ambul Thiyal while maintaining or enhancing its product quality in comparison to conventional packaging and vacuumed packaging. A comprehensive experimental setup is conducted to compare the performance of the newly evaluated MAP system with the existing conventional packaging and vacuumed packaging. Both qualitative and quantitative analyses are performed on samples stored in each packaging type, including sensory evaluations, microbial growth assessments, pH levels, and moisture content levels. The results of the study demonstrate that the modified atmosphere packaging successfully extends the shelf life of Ambul Thiyal by retarding microbial growth and reducing oxidative deterioration. Moreover, the sensory evaluations reveal that the product quality is preserved or enhanced under the proposed MAP system when compared to conventional packaging and vacuumed packaging. Sample set 01 was considered as the current conventional package (clay vessels). Samples set 02 was considered as MAP packaged samples. Samples set 03 was considered as vacuumed packaged samples.

Keywords—Modified-atmosphere-packaging, ambul-thiyal, vacuum packaging

I. INTRODUCTION

Sour fish curry, popularly known as "Ambul Thiyal," is a traditional South Asian delicacy cherished for its unique blend of tangy and spicy flavors. The perishability of Sour Fish Curry (Ambul Thiyal) poses a significant challenge to its domestic usage, commercial distribution, and consumer satisfaction. Conventional packaging methods have been insufficient in preserving the Sour fish curry's freshness and sensory attributes, leading to limited shelf life and potential food wastage.

The main objective of this study is to conduct shelf-life studies to evaluate the effectiveness of the MAP in extending the shelf life of sour fish curry, considering factors such as microbial growth, physicochemical attributes such as pH, moisture content, and titratable acidity, sensory attributes like texture, color, odor, flavor, hardness and chemical changes over time.

While MAP has been extensively studied for various perishable food products, there is limited research specifically focused on traditional or ethnic dishes like sour fish curry. To date, there are no studies available for vacuum packaging of Sour Fish Curry. Also, in this study, sensory evaluation analysis, physicochemical analysis, and microbiological analysis were done. MAP parameters like gas composition, packaging material, and temperature that are optimal for preserving the quality and extending the shelf life of sour fish curry.

II. MATERIALS AND METHOD

First, the skip jack tuna fish was washed well and cut into small pieces. Then the fish pieces were washed and cleaned again. Then goraka paste (*Garcinia cambogia*), pepper, curry leaves, and salt were added to the fish. They were mixed together with fish pieces and they were marinated and the pieces were placed in order in the clay pot. It was then cooked on low heat for about an hour until the water is evaporated. The pieces were then kept outside to release the steam before being packed. Samples were prepared according to the recipe mentioned in Tab. 1.

TABLE 1. RECIPE OF SOUR FISH CURRY USED IN THIS RESEARCH STUDY

Recipe - Sour Fish Curry (Ambul Thiyal)		
Ingredients	Weight (g)	Percentage (%)
Tuna Fish	1000	80
Goraka	125	10
Salt	30	2.4
Pepper	30	2.4
Curry Leaves	15	1.2
Water	250	4

Initially, three sets of samples were arranged. Each set had 7 samples for 21 days. The first sample set had the current conventional package (Clay vessels). The second Sample set had the Modified Atmosphere Package. (30% CO₂ & 70% N₂) [5]. The third Sample set had the vacuum package.

Tests were performed every three days for samples of three sets. After a sample reached a level which is not further acceptable, tests were not continued anymore. pH value, titratable acidity (Eq.1) and moisture content(Eq.2) were measured as the physicochemical measurements.

$$\%Titratable\ Acidity = (N \times V \times k) / w \dots\dots\dots (1)$$

N = Normality of standard NaOH solution used for titration

V = Volume of standard NaOH used for titration

k = Molecular weight of the predominant acid in the sample divided by the number of hydrogen ions in the acid molecular that are titrated

Acidity was expressed as percent of hydroxy citric acid by weight [2]

w = Weight of the sample

$$Moisture\ Content\ (\%) = ((W1 - W2) / W1) \times 100 \dots\dots (2)$$

W1 = the initial weight of the food sample before drying.

W2 = the weight of the food sample after drying.

Fish Ambul Thiyal samples, stored at room temperature were analyzed for the level of microorganism count by aerobic plate counts (APC) using the ISO 4833-1:2013 method and yeast & mold counts using the ISO 21527:2008 method.

Sensory evaluation was performed every three days for three sample sets. The samples were tested for color, odor, texture, hardness, flavor, and overall acceptance. The tests were carried out by an untrained panel of 10 judges and the samples were evaluated at room temperature. The sensory analysis of Fish Ambul Thiyal was carried out using a nine-point hedonic scale for acceptability to determine the best preservative method. Also, the descriptive analysis was done.

III. RESULTS AND DISCUSSION

When measuring the values of physicochemical parameters, the average value of the triplicated samples was applied. Physicochemical testing was performed by every 3 days for sample 01, sample 02 and sample 03. But sample 01 was out of its shelf life on day 03. After day 03, the tests were done only for sample 02 and sample 03. The variation of titratable acidity (Fig. 1), pH value (Fig. 2), moisture content (Fig. 3) mentioned below

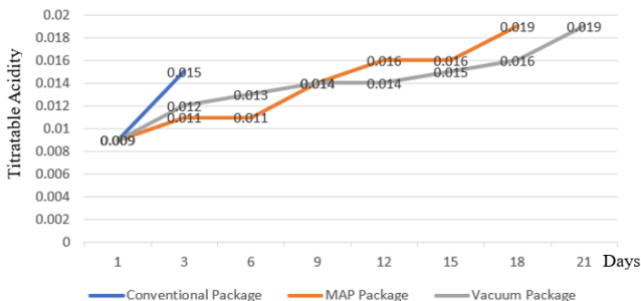


Fig. 1: Titratable acidity variance of three sample sets with the time

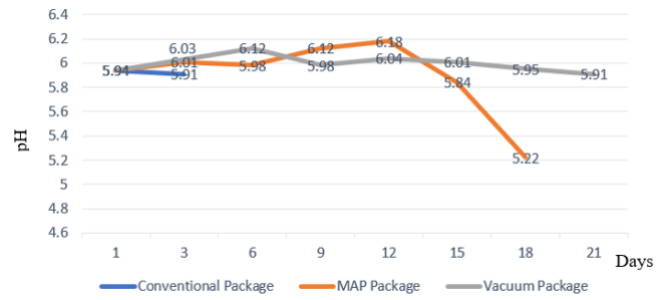


Fig. 2. pH variance of three sample sets with the time

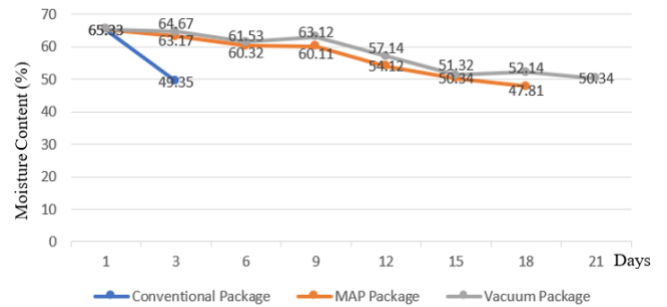


Fig. 3. Moisture content variance of three sample sets with the time

Aerobic Plate Count (APC) and yeast & mold count (Y/M) were determined as microbiological testing for all samples at ambient temperature. The results are mentioned as Colony-Forming Units per Gram of material (cfu/g). The variation of Aerobic Plate Count (Fig. 4) and yeast & mold count (Fig. 5) mentioned below.

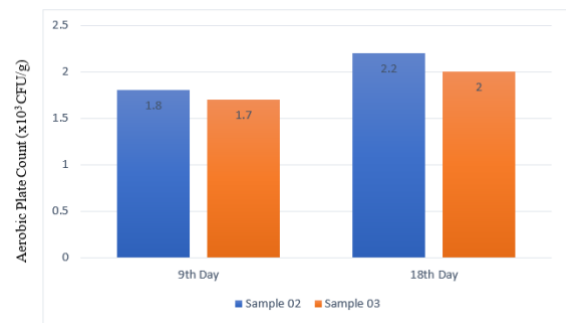


Fig. 4. Aerobic plate count in sample 02 and sample 03 on day 09 and day 18

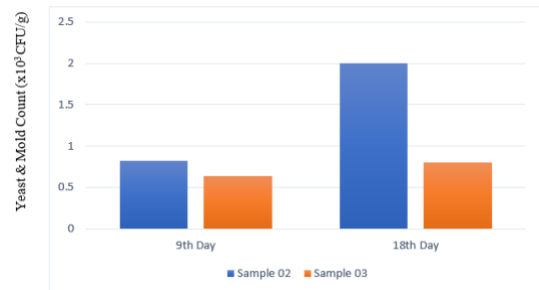


Fig. 5. Yeast and mold count in sample 02 and sample 03 on day 09 and day 18

The color of sample 03 remained intact at 21 days, but sample 02 became not acceptable at 18 days. The color of sample 01 was not acceptable on day 03. the odor of sample

03 remained intact at 21 days, but sample 02 became not acceptable at 18 days. The odor of sample 01 was not acceptable on day 03. The texture of sample 03 remained intact for 21 days. Although sample 02 had not reached not acceptable level within 18 days, the texture P value of sample 02 on day 18 showed a significant difference to the control sample ($P < 0.05$). The hardness of sample 03 remained intact for 21 days, but sample 02 was not acceptable on day 18. The hardness of sample 01 had become not acceptable on day 03. The flavor of sample 03 remained intact for 21 days, but sample 02 was not acceptable on day 18. sample 03 had become not acceptable on day 03. The sensory evaluation for flavor was not done for sample 01 on day 03 and sample 02 on day 18. The overall acceptance of sample 03 remained intact in 21 days, but sample 02 became not acceptable on day 18. The overall acceptance of sample 01 had become not acceptable on day 03.

IV. CONCLUSION

In this study, sample set 01 was considered as the current conventional package (clay vessels). Samples set 02 was considered as MAP packaged samples. Samples set 03 was considered as vacuumed packaged samples. All the samples were kept at ambient temperature. Though the titratable acidity values can be considered overall as an increase with time from the beginning, sample 01 showed a sudden increase while sample 02 and sample 03 showed a slight increment. The pH value of sample 02 showed a higher variance within 18 days, but the pH value of sample 03 showed only a slight variance within 21 days. The pH value of sample 01 reached the not acceptable level with a slight decrease.

Aerobic Plate Count (APC) and yeast & mold count (Y/M) were determined as microbiological testing for all samples at ambient temperature. APC Count and Y&M count of sample 02 were higher than sample 03 on day 09 and day 18.

Therefore, the conclusion of sensory evaluation was for Sample 03, every sensory parameter is at an acceptable level in 21 days. But in sample 02, every sensory parameter is at an acceptable level for 15 to 18 days. Sample 01 every sensory parameter is at an acceptable level for 1-3 days. Considering all the above facts, sour fish curry (Ambul Thiyal) in the vacuumed package can be kept for a longer time. Compared with the vacuumed package, the MAP package can be kept for a little less time. Both the vacuumed packaged and MAP packaged samples can be kept longer time compared to the current conventional package.

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