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# Phsicochemical characteristics of yogurt with added lamota *(Salicornia europaea)* extract: A chemistry education study

**Dwi Juniarti Nur Hamzah[1]*, Baiq Ayu Aprilia Mustariani[1], Sulistiyana[1]**

[1]Chemistry Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Mataram, Mataram, Indonesia.

*email: 220109033.mhs@uinmataram.ac.id

**Abstract.**
*This study aims to determine the physicochemical characteristics (moisture content and total phenolic content) of yogurt products with added Lamota (Salicornia europaea) extract. The research method employed a laboratory experiment, with yogurt formulations consisting of four Lamota extract volume formulations, namely F0 (0 mL), F1 (10 mL), F2 (20 mL), and F3 (30 mL). Moisture content was determined using the oven-drying method, while total phenolic content was analyzed using the Folin-Ciocalteu method with a UV-Vis spectrophotometer at a wavelength of 765 nm. The results showed that the addition of Lamota extract increased the average moisture content linearly, namely F0 (86.26%), F1 (86.98%), F2 (88.23%), and F3 (88.89%), with all formulations meeting the SNI:2009 standard (below 92.24%). The average total phenolic content also showed a positive increase with increasing extract volume, with values of 0.592 mgGAE/g (F0), 0.634 mgGAE/g (F1), 0.721 mgGAE/g (F2), and 0.809 mgGAE/g (F3), respectively.*

**Keywords**: Yoghurt, Lamota (Salicornia europaea), Moisture Content, Total Phenolic Content, UV-Vis Spectrophotometry.

## INTRODUCTION

Yogurt is a fermented dairy product produced through the activity of lactic acid bacteria such as Lactobacillus bulgaricus and Streptococcus thermophilus, which convert lactose into lactic acid, thereby creating yogurt's distinctive texture and flavor (Adiputra, dkk., 2022). This product is classified as a functional food because it contains probiotics that are beneficial for digestive health and metabolism.

With advances in food science, yogurt is not only produced conventionally but is also being developed with the addition of natural ingredients containing bioactive compounds to enhance its functional value. One such promising ingredient is lamota (Salicornia europaea), a halophyte that grows in coastal areas with high salinity. This plant is known to contain minerals, vitamins, unsaturated fatty acids, and phenolic compounds with antioxidant activity (Kim, dkk., 2019).

Lamota *(Salicornia europaea)* is widely used as a traditional food ingredient in various countries, such as Korea, and has great potential as a raw material for functional foods due to its bioactive compounds (Sang Hoon, dkk., 2017). In addition, research shows that halophytic plants such as lamota can contribute to increased antioxidant activity in fermented food products (Handayani, 2021).

The addition of lamota extract to yogurt is thought to affect its physicochemical characteristics, particularly moisture content and total phenolic content. Moisture content affects the product's texture, shelf life, and stability, while total phenolic content is associated with

antioxidant activity (Harfiana, dkk., 2012). The determination of phenolic content is generally performed using the Folin–Ciocalteu method with UV-Vis spectrophotometry (Winarsi, dkk., 2019).

The significance of this study lies in two main areas: functional foods and chemistry education. From a food perspective, lamota (Salicornia europaea) is a local plant that has not yet been fully utilized, even though it is rich in bioactive compounds and has the potential to enhance the functional value of yogurt (Kim, dkk., 2019).

The problem-solving approach in this study was conducted using a laboratory experimental design. In this stage, yogurt was prepared by adding lamota (Salicornia europaea) extract at specific concentrations, followed by an analysis of physicochemical characteristics, including moisture content determined using the oven-drying method and total phenolic content determined using UV-Vis spectrophotometry with the Folin–Ciocalteu reagent. The results of this test were used to determine the effect of adding lamota extract on the quality of the yogurt produced.

The objective of this study was to determine the physicochemical characteristics of yogurt supplemented with lamota (Salicornia europaea) extract based on moisture content and total phenolic content.

In the context of chemical analysis, UV-Vis spectrophotometry is one of the most widely used methods for determining the concentration of certain compounds, including phenolic compounds. This method offers the advantages of high accuracy, a relatively simple procedure, and the ability to analyze the concentration of a substance based on the solution's absorbance. Therefore, the use of this method in the analysis of yogurt with added lamota extract is relevant for providing students with a more practical laboratory experience.

Research on yogurt supplemented with lamota extract also offers novelty, as there are still few studies examining its effects on physicochemical characteristics, particularly moisture content and total phenolic content. In fact, these two parameters are crucial in determining the quality of yogurt as a functional food product. Therefore, this study is expected to make a scientific contribution to the field of food technology while supporting the utilization of local natural resources with high potential.

## METHOD

### Research Design

This study employed a quantitative experimental design. The experimental phase aimed to investigate the physicochemical characteristics of yoghurt enriched with *Salicornia europaea* extract.

The experimental design used a Completely Randomized Design (CRD) consisting of four treatments: F0 (0 mL extract as control), F1 (10 mL), F2 (20 mL), and F3 (30 mL of *Salicornia europaea* extract). All treatments were prepared under standardized conditions, including milk type, starter culture, fermentation temperature, and incubation time, to ensure experimental consistency.

### Materials and Instruments

The materials used in this study included *Salicornia europaea* (lamota), skim milk, commercial yoghurt starter culture containing *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, and *Bifidobacterium*, honey, distilled water, ethanol (96%), Folin–Ciocalteu reagent, and sodium carbonate ($Na_2CO_3$ 5%).

The instruments used included an analytical balance, blender, sieve, beaker glass, Erlenmeyer flasks, pipettes, oven, desiccator, UV-Visible spectrophotometer, centrifuge, test tubes, and standard laboratory glassware.

### Preparation of *Salicornia europaea* Extract and Yoghurt Production

Fresh *Salicornia europaea* samples were collected, washed thoroughly, and blended with distilled water to obtain a crude extract. The mixture was then filtered to obtain a clear extract.

Yoghurt was produced by fermenting skim milk inoculated with a commercial starter culture under controlled temperature conditions until coagulation occurred. After fermentation, different concentrations of *Salicornia europaea* extract (F0–F3) were added to the yoghurt samples.

**Physicochemical Analysis**

The physicochemical properties of the yoghurt were evaluated through moisture content and total phenolic content (TPC) analysis. Moisture content was determined using the oven-drying method until constant weight was achieved. The percentage of moisture content was calculated based on weight loss after drying.

Total phenolic content was measured using the Folin–Ciocalteu method with UV-Visible spectrophotometry. Absorbance values were recorded and expressed as milligrams of gallic acid equivalent per gram (mg GAE/g).

**Data Analysis**

The experimental data were analyzed using descriptive quantitative methods to determine the effect of *Salicornia europaea* extract concentration on the physicochemical properties of yoghurt. The results were compared with relevant standards, including the Indonesian National Standard (SNI) for yoghurt quality.

## RESULT AND DISCUSSION

### Physicochemical Characteristics of Yogurt with Added Lamota Extract

#### Moisture content of yoghurt

Test results for the moisture content of yogurt with added lamota extract (Salicornia europaea) showed variations across each treatment (F0–F3). In general, increasing the concentration of lamota extract tended to affect the moisture content of the yogurt due to the presence of hydrophilic components, such as minerals and bioactive compounds, contained in the extract. Based on the results of laboratory observations, the following data were obtained:

**Table 1.** Moisture Content of Yogurt with Added Lamota Extract

| Formulation | Water content (%) |
|---|---|
| F0 (0 mL) | 86,26 ± 0,64 |
| F1 (10 mL) | 86,98 ± 1,19 |
| F2 (20 mL) | 88,23 ± 0,21 |
| F3 (30 mL) | 88,89 ± 0,15 |

Based on the table, it can be seen that the moisture content increases as the concentration of lamota extract increases. This indicates that lamota extract has hydrophilic properties that can enhance the water-binding capacity of the yogurt matrix.

**Figure 1**. Testing the moisture content of yogurt with the addition of lamota extract

Theoretically, the increase in water content is influenced by the soluble fiber and mineral content in the plant extract, which are capable of binding free water in the fermented milk emulsion system (Harfiana, dkk., 2012). However, all batches still fall within the standard range for yogurt as defined by SNI (92–95%), and thus still meet product quality standards.

Regarding moisture content, the analysis results showed variations in values across the different treatments involving the addition of lamota extract. Adding a certain amount of the extract can affect the material's ability to bind water, thereby influencing the yogurt's consistency. This is consistent with research indicating that the addition of plant-based additives can affect the hydrophilic properties and stability of the yogurt matrix. A moisture content that meets SNI standards indicates that the yogurt remains in the category of good quality and is safe for consumption.

**Total Phenolic Content**

The results of the total phenolic content analysis showed a significant increase as the concentration of the lamota extract increased.

**Table 2.** Average Total Phenolic Content of Yogurt with Added Lamota Extract

| Formulation | Total Fenolic Content (mg GAE/g) |
|---|---|
| F0 (0 mL) | 0,592 ± 0,653 |
| F2 (10 mL) | 0,634 ± 0,684 |
| F3 (20 mL) | 0,721 ± 1,221 |
| F4 (30 mL) | 0,809 ± 1,338 |

The results indicate that the addition of lamota extract increases the phenolic compound content in yogurt. This is due to the phenolic and flavonoid compounds in Salicornia europaea, which act as natural antioxidants.

In theory, phenolic compounds can survive the fermentation process and contribute to the antioxidant activity of the final product (Winarsi, dkk., 2019). This finding is also consistent with the study by Lee et al. (2023), which found that adding halophytes to fermented dairy products can significantly increase antioxidant content.

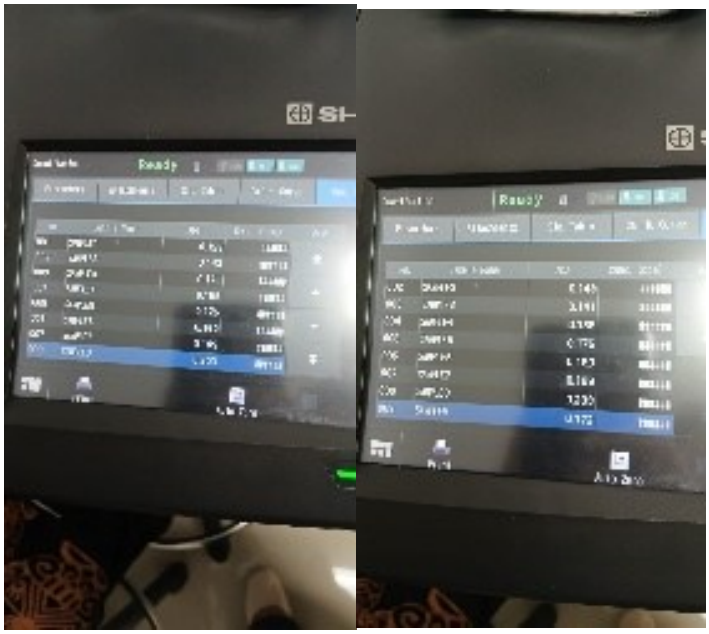

**Figure 2**. Testing the total phenolic content of yogurt with the addition of lamota extract

The total phenolic content increased with the addition of lamota extract. This is due to the phenolic compounds in lamota dissolving in the yogurt system and being detected via UV-Vis spectrophotometry using the Folin–Ciocalteu reagent. Phenolic compounds are known to act as antioxidants capable of neutralizing free radicals; therefore, an increase in phenolic content has the potential to enhance the functional value of yogurt as a health food.

In addition, the results of this study also indicate that variations in the concentration of

lamota extract tend to produce differences in each of the parameters tested. The higher the concentration of the extract added, the greater the contribution of bioactive compounds to the yogurt system, although beyond a certain limit this can affect the product's physical stability.

This indicates that formulations incorporating natural ingredients must strike a balance between enhancing the product's functional value and maintaining its physical quality. Therefore, selecting the optimal concentration is crucial for producing yogurt that not only exhibits high antioxidant activity but also meets the quality standards required by food regulations.These results reinforce the potential of lamota as a natural fortification ingredient in the development of functional food products based on fermented milk.

## CONCLUSION

Based on the research findings and discussion, it can be concluded that the addition of lamota extract (Salicornia europaea) affects the physicochemical characteristics of yogurt, particularly its moisture content and total phenolic content. The moisture content of the yogurt increased as the extract concentration increased; however, all treatments remained within the quality standards for yogurt as defined by SNI, meaning the product remains safe for consumption. In addition, total phenolic content also showed a significant increase, indicating that lamota extract serves as a source of bioactive compounds and natural antioxidants in yogurt products.

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