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Initial Development of Lamota (*Salicornia europae*) Yogurt As a Functional Drink

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Abstract

Salicornia europae is a marine plant that grows in coastal areas and tides. In Sumbawa, this plant lives in the former area of ponds and is usually called lamota. *S. europae* contains beneficial ingredients such as minerals, vitamins, antioxidants, unsaturated fatty acids, and sugars. Marine plant innovations in *S. europae*, rich in iodine in processed yogurt, have not been well explored. This study aimed to develop the processing of lamota into a functional yogurt drink. A complete randomized design (CRD) was used in this experiment, using a single factor of 6 levels of lamota concentration. Iodine content, ash content, pH, and scoring tests were carried out to determine the lamota yogurt's best quality. The results showed that the iodine content of the product was 29.01 mcg/g dry weight, and ash content was 10.59%. The pH showed that adding lamota minimally affected the pH of the yoghurt. The organoleptic test found that a 25% addition of lamota extract was the preferred concentration compared to 5, 10, 15, and 20% based on color, taste, texture, and aroma. The panelist describes the 25% lamota addition as greenish, salty, watery texture and green aroma. Based on the iodine content and the best consumer acceptance, the yogurt with a 25% addition of lamota could be categorized as rich in iodine drink and a promising product to improve the functional characteristics of yogurt and develop a value-added local marine commodity with a unique flavor.

INTRODUCTION

Salicornia europae, or sea asparagus, locally known as lamota, is a promising candidate for saline farming due to its tolerance to high salt concentrations. This sea asparagus has a signature taste and contains several health benefits, including sufficient mineral content. This plant is usually consumed after minimal processing, such as steaming, salting, or frying, or consumed raw as a snack by the locals. A previous study found that *S. europae* also contains many health-beneficial ingredients

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such as minerals, vitamins, antioxidants, unsaturated fatty acids, and sugars. In Korea, this plant is extracted as a vegetable oil for cooking and widely utilized as a tea-premix, nuruk (fermented drink), makgeolli (rice wine), and vinegar (Song *et al.,* 2013; Kim *et al.,* 2013).

Lamota is known to be an environmentally friendly plant because of its capability to reduce CO_2 emissions. This plant is capable of binding CO_2 during growth. The by-product of *S. europeae* seeds could be used as animal feed in the form of flour. The flour and biomass *S. europae* serves as a mixture of animal feed and can substitute up to 30% in the ratio of ruminant fodder, either in the form of plant hay or flour from seeds. *S. europae* contains sodium carbonate that has the potency to reduce symptoms of diabetes, asthma, hepatitis, cancer, and gastroenteritis (Essaidi *et al.,* 2013). This plant usually grows in coastal areas and tidal marshes in the northern subtropics and South Africa. In Indonesia, this plant is widely found in former pond areas.

Figure 1. Marine plant *S. europae* in Sumbawa Empang-Plampang Regency.

This marine plant is widely found in Sumbawa Regency, such as in the Plampang, Tarano, and North Moyo districts. Local inhabitants usually consume signature dishes such as urap daily, but the nutritional content of the plants has not been well explored scientifically. The local people know that this plant has a salty taste, possibly due to its mineral contents. Iodine is one of the micro-minerals that are possibly available in marine products that affect thyroid hormones in regulating the body's metabolism and increasing the growth and development of the body's organs, including the brain. Lack of iodine leads to a bigger size of the thyroid gland. The overgrowth of the thyroid gland is called goiter disease (Kapludin and Amarlita, 2016).

Thus, lamota plants potentially developed into commercial products since the plants were abundantly grown and minimally utilized by the local community. The lamota processing is expected to reduce iodine deficiency and escalate the economic status of the local community. Yogurt is one of the functional drinks through milk fermentation by the *Streptococcus thermophillus* and *Lactobacillus bulgaricus* (Wijaya *et al.,* 2012). Yogurt may be formulated into various flavors that attract consumers, including children, adults, and older groups. Yogurt is easily digested compared to whole milk and has many health benefits, such as improving digestive tract health, regulating cholesterol levels, anti-cancer, and anti-diarrheal (Manurung *et al.,* 2014). Based on this background, this study aimed to initially develop yogurt products (Salicornia europae) as functional drinks to increase consumers' interest in consuming nutritive drinks.

METHODOLOGY

Ethical Approval

There are no animals harmed or improperly treated during this research.

Place and Time

This research was conducted in September-December 2022. The research was carried out at the Food and

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Agroindustrial Laboratory, Faculty of Agricultural Technology, Sumbawa University of Technology.

Research Materials

The tools used in this study were a Shimazdu 1700 UV-Vis spectrophotometer, furnace, blender, container, stove, filter paper, spoon, drip pipette, electric oven, measuring cup, pH meter, and analytical scale. The material used in this study is S. Europae obtained from Empang-Tarano District, Sumbawa, cow's fresh milk, skim milk powder, starter yogurt (ST, LB), and KIO_3.

Research Design

The data collection method used is the purposive sampling method. The experimental design used was a Complete Randomized Design (CRD), with a single factor of 6 levels of *S. europeae* concentration 0%, 5%, 10%, 15%, 20%, and 25%.

Work Procedure

Iodine Content

Iodine was tested using the spectrophotometry method, which refers to the previous method (Untailawan *et al*., 2019). A total of 1 gram of sample was mashed, heated for 15 minutes at 100 ºC, and mashed with a mixture of 50 ml KI and 50 ml H_3PO_4. The sample was then filtered by using Whatman paper and measured at a wavelength of 280 nm. Iodine levels were calculated by using the standard curve equation.

Ash Content

Ash content referred to the prior method (Sunartaty and Yulia, 2017). Samples were cleaned using clean water. The sample was steamed using a pressure cooker. Then, the sample is made in the form of an extract using a blender. The extract was put in a container and then dried using an electric oven at 500-600 ºC for six hours. Then, the ash content was calculated from the difference in the net weight of the sample minus the mineral weight from combustion.

Yogurt Production

The tools were sterilized by using boiling water. A total of 1 liter of milk was pasteurized at 75 ºC for 10 minutes to reduce the number of microbes. The milk was cooled at 40 ºC, and 10 g of ST LB starter was added. The yogurt is homogenized and stored in a sealed container for fermentation for 24 hours at room temperature.

S. europae was extracted by maceration method, then filtered and sterilized at a temperature of 121 ºC for 10 minutes. Extract *S. europae* was mixed with a set of yogurt with concentrations 5, 10, 15, 20, and 25%.

Organoleptic Test

A hedonic rating test using 16 panelists was conducted to determine the best formulation of the five treatments with a scale of 1-4 on texture, aroma, taste, color, and overall favorability attributes.

Data Analysis

The data were tabulated and then analyzed by using SPSS 22 software using Analysis of Variance (ANOVA) at a real level of 5%. The post-doc analysis was carried out using the Duncan test.

RESULTS AND DISCUSSIONS

Based on the iodine test, iodine levels were 29.01 mcg/g. This amount is much greater when compared to other marine plants such as seawater and *Euchema cottoni*, which were assessed with the same method in the Indonesian region, such as in Maluku and the Kei Kecil Islands that ranged from 0.2 – 6.3 g/kg dry weight (Dulanlebit *et al.*, 2020). Food is high in iodine if it meets 30% of the daily recommendation intake (RDI) in 100 g in the form of solids and 15% in 100 ml of liquid (Food and Drug Agency of the Republic of Indonesia, 2005). The recommended consumption of iodine per day for adults is 150 mcg per day, and it requires about five mcg *S. europae* in a day to fulfill the RDI.

Ash content is an inorganic substance left over from the combustion of an organic matter. The ash content is related to the

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number of mineral elements in the material. In addition, the levels of each mineral component are determined by species, factors, and physiological, and geographical conditions (Kusumawati *et al.,* 2019). Based on the measurement of ash content obtained, 10.59% per dry weight of the samples. The ash content of the product indicates its purity, which is influenced by the mineral content of the raw material. The higher the ash content value, the greater the number of inorganic materials inside the food.

Organoleptic scoring tests were conducted on 15 panelists on color, aroma, taste, texture, and overall acceptance. Based on the Duncan test (Figure 2), there was a significant color difference by adding 25% of the lamota extract to the green color attribute. The green color is derived from the green pigment of *S. europae*. In sensory attributes, green is associated with green attributes, which indicate that the material is naturally made and healthy for consumers (Koli *et al.,* 2022).

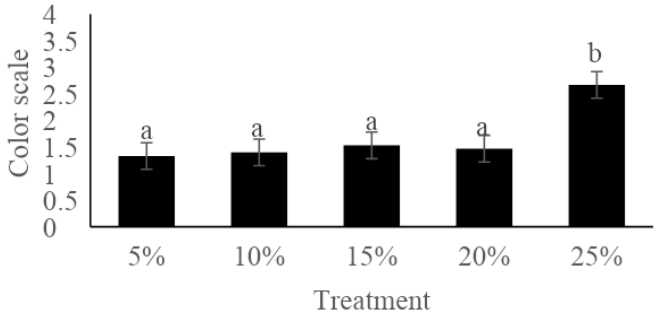

Figure 2. Color results on *S. europae* yogurt.

The addition of *S. europae* extract of 5 and 10% does not cause any significant aroma to the yogurt. The panelist observed no green aroma at this concentration. Meanwhile, 15-20% of the aroma of leaves derived from *S. europae* was inimally increased. A significant green aroma was observed in the 25% addition of the extract (Figure 3).

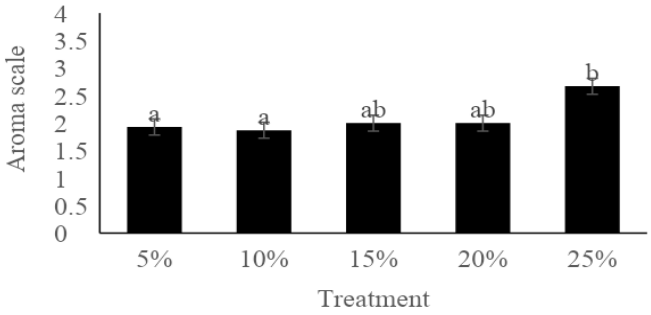

Figure 3. Aroma results on *S. europae* yogurt.

S. europae grows in tidal areas, affecting the plants' flavor. Salty is the major attribute of *S. europeae* taste. Based on the organoleptic test, there was no significant differences were found in the salty taste of yogurt products with the addition of *S. europae* from 5 to 25% (Figure 4). The average treatment was scored 2, indicating that the yogurt's saltiness was low, even undetectable in several panelists.

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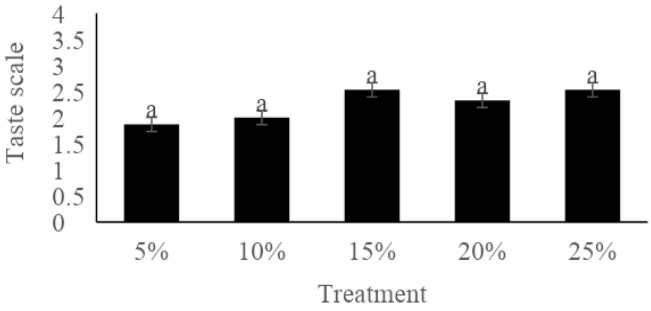

Figure 4. Taste results on *S. europae* yogurt.

The higher amount of *S. europae* extract added affects the texture of the yogurt in water. It was due to the consistency of the extract that macerated in water. The addition of extract could change the consistency of the yogurt from set into drink yogurt which also increases the acceptability of the yogurt (Figure 5).

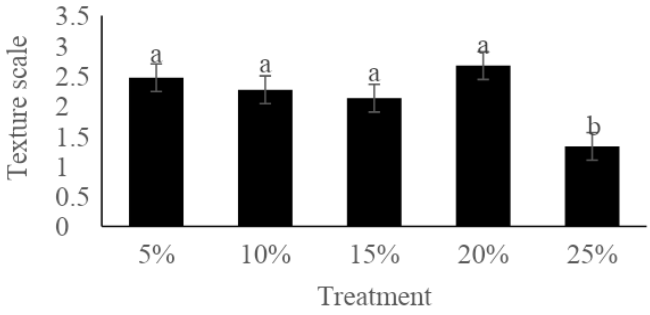

Figure 5. Texture results on *S. europae* yogurt.

The overall acceptability of the yogurt showed a significant acceptance with the addition of *S. europae* at 25%, with an overall score of about three that indicated the consumer's liking for the treatment (Figure 6). The addition of 25% *S. europeae* possibly increases the consumer score of acceptability because of the ability of the extract to improve the color, bring a unique aftertaste, and mask the barny flavor in the yogurt.

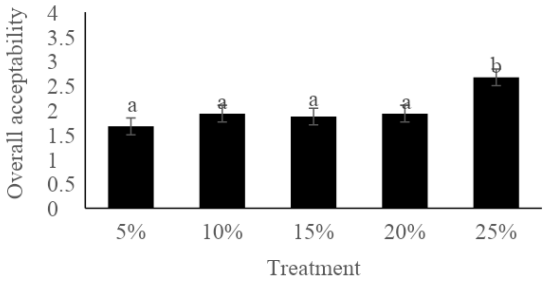

Figure 6. Overall acceptability result on *S. europae* yogurt.

The addition *of S. europae* also had a positive impact with increased favorability levels as well as the chances of increasing the amount of iodine contained in *S. europae*. Thus, allows for a high claim of iodine on the packaging label in a single dish. The results of the yogurt acidity (pH) test in each treatment are presented in Table 1.

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Table 1. Yogurt pH measurement results.

Treatments	Deuteronomy			Average
	1	2	3	
S. europae 5%	5.72	5.61	5.63	5.65
S. europae 10%	5.77	5.76	5.67	5.73
S. europae 15%	5.78	5.77	5.69	5.75
S. europae 20%	5.69	5.97	5.73	5.80
S. europae 25%	5.86	5.62	5.68	5.72

The acidity is one of the most important factors that affect the growth of microorganisms and the formation of fermentation products because each microorganism has an optimal pH range. Based on the results of the yogurt pH (Table 1), the pH value correlates with the total lactic acid bacteria in the product. The increase in pH follows a decrease in lactic acid levels in yogurt. Changes in lactic acid can affect the rate of dissociation of H^+ ions, resulting in changes in the pH of the media (Ariyana *et al.,* 2022). Our present result was fulfilling in the range.

CONCLUSION

The test results of iodine content and ash content of S. *Europae* show the optimal value in food raw material standards. Iodine content was 29.01 mcg/g, and ash content was 10.59%. Based on color, taste, texture, and aroma with S. e*uropae* 5%, 10%, 15%, 20%, and 25% addition, the last treatment was the most preferable concentration of the addition. The 25% addition of *S. europeae* extract into yogurt could improve the nutritive value as well improving the acceptance of the consumers.

CONFLICT OF INTEREST

There is no conflict of interest in this manuscript between all authors upon writing and publishing this manuscript.

AUTHOR CONTRIBUTION

The contributions of each author are as follows; Ratna Nurmalita Sari collected and analyzed data, Imam Munandar followed the conception, design experiments, drafting and drafting of the manuscript, Adi Suriyadin and Ariv Rahman Havied drafted the manuscript and revised it.

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