

INNOVATION OF HEALTHY SNACKS: SEAWEED PUDDING (*EUCHEUMA COTTONI*) WITH TELANG FLOWER EXTRACT (*CLITORIA TERNATEA*) AS AN IMMUNE BOOSTER FOR SCHOOL CHILDREN

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ABSTRACT

School-aged children are a vulnerable group prone to nutritional disorders and decreased immunity due to the consumption of unhealthy snacks. This study aimed to develop an innovative healthy snack in the form of pudding made from seaweed (*Eucheuma cottonii*) with the addition of Telang flower extract (*Clitoria ternatea*) as a natural immune booster. The research used a Completely Randomized Design (CRD) with four formulations (FO, F1, F2, F3) and two replications. The organoleptic test involved 25 panelists to evaluate the color, taste, aroma, and texture of the product. Nutritional content was analyzed through proximate testing, and antioxidant activity was measured using the DPPH method. The results showed that formulation F3 (60 g seaweed + 500 ml Telang extract) had the highest organoleptic acceptance and the highest antioxidant content. The addition of Telang significantly increased the nutritional value (in terms of protein, fiber, and antioxidants) and the overall acceptability of the product. Therefore, seaweed pudding with Telang has the potential to be a nutritious and functional healthy snack alternative to enhance the immunity of school children.

Keyword: antioxidants; immune booster seaweed; telang flower

INTRODUCTION

According to the World Health Organization (WHO) definition, school-age children are those aged 7-15 years. In Indonesia, the age range is typically 6-12 years (Ministry of Health, 2008). Elementary school-age children are a crucial age group in human development. Children between 6 and 12 years old are included in the elementary school age category. Children experience rapid development at this age. Through various developmental aspects, children's development follows unique patterns. Several aspects develop rapidly during elementary school age, including language, emotional, and social development. These aspects are strongly influenced by the home, school, and peer environments (Zakiyah et al., 2024). School-age children are an age group experiencing rapid growth and development, both physically and mentally. Elementary school-age children are a crucial age group in the stages of human development. During this period, the need for balanced nutritional intake is crucial to support daily activities and maintain endurance. However, the reality is that many school children have busy schedules, ranging from school activities, extracurricular activities, to extracurricular activities. This busy schedule often leaves them feeling tired, lacking rest, and tending to neglect healthy eating habits. Many school children prefer fast food or snacks that are unhygienic and low in nutrition. Repeated consumption of unhealthy snacks can weaken children's immune systems, making them more susceptible to disease (Zakiyah et al., 2024). Balanced nutrition also plays a crucial role in strengthening the immune system, thus preventing pathogens that could potentially disrupt their activity, growth, and development. Snacks are a source of nutritional intake for children. However, research shows that the majority of school children tend to choose unhealthy snacks, which contain colorings, sweeteners, and other additives that are not recommended for consumption. Therefore, healthy and nutritious snacks are needed, including those containing antioxidants to help strengthen the immune system (Jalaludin et al., 2023).

Healthy snacks are snacks or light meals that contain good nutrition for the body and are free from harmful substances. Healthy snacks also contain balanced nutrition such as protein, carbohydrates, fat,

and high fiber, and are free from preservatives, artificial colors, and excess sugar. Meeting the nutritional needs of school-age children can prevent nutritional problems. Providing foods with good nutritional content is one effort that can be made to meet nutritional needs (Hervidea & Dalimunthe, 2024). One healthy snack innovation that can be created to meet children's nutritional needs and improve the immune system of school-age children is pudding. Pudding is one food product that is attractive to school children because of its beautiful color, soft texture, and variety of shapes. One basic ingredient that can be used in making healthy pudding is seaweed, specifically *Eucheuma cottoni*. This type of seaweed is a local food rich in fiber, minerals, and bioactive compounds that are beneficial for health, including supporting the digestive system and boosting the immune system. Furthermore, minerals such as iodine, calcium, iron, and magnesium are essential for supporting growth and maintaining children's bodily functions. Seaweed also contains antioxidants and vitamins that play a role in boosting immunity, preventing children from getting sick easily. This pudding is presented in an attractive pudding form, with the addition of natural coloring from Telang flower extract (*Clitoria ternatea*). This innovation is more easily accepted by children due to its colorful appearance and delicious taste (Sari et al., 2022).

The Telang flower (*Clitoria ternatea*) is a common plant. This plant usually grows climbing on fences and is known for its striking blue flowers. Telang flowers contain various active compounds that are beneficial for health. One of the main ingredients is anthocyanin, a type of natural antioxidant that functions as an immune booster or enhances the body's resistance. This antioxidant can fight free radicals in the body, thus preventing various diseases and maintaining an optimal immune system. In addition to its health benefits, the natural color of Telang flowers can be used to make food more attractive without the need for artificial coloring. Natural coloring is made through extraction from plants, animals, or other natural sources. When used in food, natural dyes are much safer and less harmful to health. (Nafis et al.,). Through the innovation of healthy snacks in the form of pudding made from seaweed (*Eucheuma cottonii*) enriched with Telang flower extract, it is hoped that it can be a solution in providing an alternative snack that is not only delicious and attractive, but also nutritious and beneficial for children's health (Amarullah et al., 2024).

METHOD

This study used an experimental approach with a completely randomized design (CRD) consisting of four treatment formulations: F0 (control), F1, F2, and F3, each replicated twice. The objective of this study was to develop a healthy snack innovation in the form of seaweed (*Eucheuma cottonii*) pudding with the addition of Telang flower (*Clitoria ternatea*) extract as an immune booster for schoolchildren. This study was conducted in June 2025, with the hedonic test conducted at Mitra Indonesia University and laboratory tests (proximate and antioxidant tests) conducted at the POLINELA Food Technology Laboratory. The main ingredients used were seaweed, Telang flowers, sugar, pandan leaves, vanilla, and water.

Table 1.

Here is the seaweed pudding formula with Telang flower extract

Treatment	Seaweed E. cottoni	Telang flower extract
F0	60 gr	
F1	60 gr	100 ml
F2	60 gr	200 ml
F3	60 gr	500 ml

The research procedures included the preparation of Telang flower extract using a brewing method, the processing of seaweed through soaking and boiling, and the preparation of pudding by mixing the ingredients according to the formulation. After the pudding was finished, a hedonic test was conducted by 25 UMITRA student panelists to assess color, taste, aroma, and texture based on a preference scale.

Next, laboratory analysis included a proximate test to determine moisture, ash, fat, protein, and carbohydrate content (by difference), and an antioxidant activity test using the DPPH method to measure the IC₅₀ value of the pudding extract. Data analysis was performed using a one-way ANOVA to compare results between formulations, followed by a T-test for proximate and antioxidant data to determine the significance of differences between treatments. Throughout the study, ethical aspects of the research were also considered, such as obtaining informed consent from the panelists, maintaining data confidentiality, and explaining the benefits and risks that may arise during the research process.

RESULTS AND DISCUSSION

Mitra Indonesia University served as the research site. The demographic address of UMITRA is Jl. ZA. Pagar Alam, Gedong Meneng, Rajabasa District, Bandar Lampung City, Lampung Province 40115. UMITRA students from the 23rd batch served as panelists for the hedonic test. Subsequent research examined proximate and antioxidant testing at the Food Technology Laboratory of the Lampung State Polytechnic (POLINELA). POLINELA is located at Jl. Soekarno-Hatta No. 10 Rajabasa Raya, Rajabasa Regency, Bandar Lampung City, Lampung 35141, is the geographic location of POLINELA.

Hedonic Test

The hedonic test is the panelist's response to their likes or dislikes of the commodity being evaluated, even with a level of like or dislike expressed on a hedonic scale (Sari Putri & Mardesci, 2020). The senses used to assess sensory properties are taste, smell, touch, and sight. In this study, a hedonic test was conducted to determine consumer preference for color, appearance, texture, and taste (Pamela et al., 2022). Four samples, F0, F1, F2, and F3, were assessed by a panel of 25 respondents, assessing color, taste, aroma, texture, and overall taste.

Table 2
 The following is a table of average hedonic tests

No	Sample	Taste	flavour	Colour	Texture
1	F0	2.44	2.8	2.76	2.56
2	F1	2.36	2.52	2.64	2.44
3	F2	2.68	2.88	3.24	2.76
4	F3	3.44	3.16	4.04	3.2
	<i>P-value</i>	.000	.013	.000	.006

Based on the data in the table above from the results of the hedonic test on E cottoni seaweed pudding with Telang flower extract F0, F1, F2, and F3, the results obtained based on the taste parameter obtained the highest mean rank value in F3, namely (3.44), in the aroma parameter obtained the highest mean rank value in F3, namely (3.16), in the color parameter obtained the highest mean rank value in F3, namely (4.04), in the texture parameter obtained the highest mean rank value, namely (3.20). The addition of 500 ml of Telang flower extract can increase the value of the preference number in E cottoni type seaweed pudding with a P-value <0.05, showing significant results, namely, there are real differences from each formula in each parametric taste, aroma, and texture.

Based on the hedonic test, according to Hapsari (2021), the increase in color in F3 was due to the higher addition of Telang flower extract, resulting in a higher level of preference for the product color, because the extract provides an attractive and fresh visual appearance. Meanwhile, the increase in taste in F3 is supported by Yuliana's (2021) research that Telang flower extract has a light, slightly sweet, and not bitter taste when used in the right amount, without disturbing the basic taste of the pudding, so that it is preferred by panelists. The increase in aroma in F3 was also because the Telang flower extract did not provide a dominant aroma, so the aroma of the pudding was greatly influenced by other basic ingredients

such as seaweed, vanilla, or pandan. Then, according to Idrus & Renata (2023), the addition of Telang flower extract to F3 did not disturb the basic texture, instead maintaining the softness of the pudding, and it was easily crumbled, so that it was considered satisfactory to panelists.

Proximate Test

A proximate test on *E. cottoni* seaweed pudding with Telang flower extract was conducted on F0 and F3 based on the hedonic test results. A proximate test was then performed with two repetitions on F0 as a comparison and F3 to determine nutritional content. A proximate test is an analysis conducted. To determine the chemical composition of a material, including water, ash, protein, fat, and carbohydrate content (Endah Dwijayanti et al., 2023).

Table 3

The following table shows the average results of the proximate test

Sample	Water	Ash	Protein	Fat	Fiber	Carbohydrate
F0	84.4072	0.4668	1.3682	1.6061	1.2159	12.1518
F3	80.3931	1.1754	2.0861	2.4339	1.9453	13.9115
P-value	.001	.001	.002	.036	.000	.002

Description:

F0: *E. cottoni* seaweed pudding 60 g

F3: *E. cottoni* seaweed pudding with Telang flower extract 500 ml

Sample F0 (control) had the highest water content at 84.43%, but its nutritional content was relatively low, particularly in protein, fat, and fiber. Conversely, sample F3, containing Telang flower extract, saw a decrease in water content to 80.28%, indicating an increase in solids concentration. Furthermore, there was a significant increase in ash (1.15%), protein (2.08%), fat (2.63%), crude fiber (1.95%), and carbohydrate (13.84%) content. This indicates that the addition of Telang flower extract enriches the nutritional value of the pudding product, particularly in macronutrient content, and helps reduce water content, potentially extending shelf life. Thus, the F3 formula is superior and has the potential to be a healthy, nutritious, and functional snack option for school children.

Based on the results of the proximate test, the decrease in water content in F3 was due to the fiber content and active compounds from seaweed and Telang flowers interacting with water and forming a gel. Therefore, the water trapped in the gel matrix was not measured as free water content (Hidayatulbaroroh, 2023). According to Suhardiyanto (2020), the increase in ash content in F3 was due to the high concentration of Telang flower extract, which significantly increases the ash content in processed products due to the increased mineral content of the additives. Meanwhile, the increase in fat content in F3 was due to the Telang flower extract containing not only pigments and polyphenols but also natural fats. The higher the extract volume, the higher the proportion of fat (Rahayuningsih, 2023).

The increase in protein in F3 is also thought to be due to the nutritional content of Telang flower extract, which is known to contain active compounds such as anthocyanins, flavonoids, and vegetable protein. Furthermore, the increase in fiber content in F3 is due to the known content of fiber components such as cellulose and hemicellulose, which are beneficial for digestive health. According to Lokhande (2019), the increase in F3 in carbohydrates is because Telang flower extract contains polysaccharides, including soluble fiber and complex sugars such as glucose, fructose, and arabinose, which can contribute to the total carbohydrates in the final product.

Antioxidant Testing

The antioxidant test on *E. cottoni* seaweed pudding with Telang flower extract was conducted on the

best formulation based on the hedonic test results. The antioxidant test was then conducted to. Determine the antioxidant content of the pudding. The antioxidant test results are shown in the table below:

Table 4

Sample	Average Results of the Antioxidant Test		
	%Inhibisis	IC50	P-value
F0	32.12	3488.30	.032
	32.41		
	33.18		
	33.60		
	34.15		
F3	32.33	2791.52	
	32.88		
	33.35		
	34.28		
	34.92		

Formula F0, a seaweed pudding without the addition of Telang flower extract, achieved a percentage inhibition value ranging from 32.12% to 33.60%. The IC50 value for formula F0 was 3488.30 ppm, indicating that the concentration required to inhibit 50% of free radicals is quite high. This indicates that the antioxidant activity of formula F0 is relatively low. Meanwhile, formula F3, a seaweed pudding with the addition of 500 ml of Telang flower extract, experienced an increase in antioxidant activity. This is indicated by an increase in the percentage inhibition value, which ranged from 32.33% to 34.92%. The IC50 value for F3 was also lower, at 2791.52 ppm, indicating that the F3 sample had better antioxidant capacity than F0.

However, according to research by Chusniati (2021), the presence of antioxidant compounds still has a positive contribution to the body, particularly in counteracting free radicals that can damage cells and tissues. Therefore, despite its low activity level, seaweed pudding with Telang flower extract still has potential as an immune booster for schoolchildren. The anthocyanin content of Telang flowers can help reduce oxidative stress, while the fiber from the seaweed supports digestive health, which plays a vital role in the immune system. With the right formulation and increased concentration of active ingredients, this pudding could become an innovative healthy snack that is not only attractive in color and taste, but also functionally beneficial in boosting children's immune systems.

Research Limitations

This study has limitations, including the fact that the antioxidant compounds in seaweed and Telang flower extract are sensitive to high temperatures. Heating above 60°C can damage the chemical structure of these compounds, reducing their antioxidant activity. Therefore, temperature control during pudding preparation is crucial to maintain the effectiveness of the antioxidants in the product.

CONCLUSION

The results showed that formula F3, a *Eucheuma cottonii* seaweed pudding with the addition of 500 ml of Telang flower extract, achieved the highest hedonic value (13.84) compared to the other formulas, in terms of taste, aroma, color, and texture. Based on these results, F3 was determined as the best formulation and compared with F0 (control) in proximate and antioxidant tests. Laboratory tests showed that F3 experienced a significant increase in nutritional content, namely protein (2.0861%), ash (1.1754%), fat (2.4339%), crude fiber (1.9453%), and carbohydrate (1.7597%), with a decrease in water content of 4.0141%. Furthermore, the antioxidant activity of F3 was higher with an IC₅₀ value of 2791.52

µg/mL, compared to F0's 3488.30 µg/mL, indicating that the lower the IC₅₀ value, the higher the antioxidant capacity.

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