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Exploring the Characteristics and Applications of Eucheuma Cottonii Seaweed Flour in Crepe Production

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript

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ABSTRACT

These days, people eat to focus on their hunger, meet their nutritional needs, and lower their risk of illness. People are conscious of nutritional facts. Individuals are beginning to read the ingredients listed on every food product they purchase and see if it's good for their health. A wide range of food products that compromise diet benefits and health and provide basic nourishment has been developed in response to public demand. Until now, very little research has been done on substituting *Eucheuma cottonii (E. cottonii*) powder for wheat flour to make crepes. Crepe is a dessert that is filled with many kinds of mixtures. Seaweed has a relatively high nutritional fiber content and is high in carbohydrates. Seaweed's economic and practical worth can be raised by turning Eucheuma cottonii seaweed into flour to substitute wheat flour for crepe.

Consequently, the current study's objectives were to create a seaweed crepe recipe using powdered seaweed and assess the effects of E. cottonii powder on the physical and chemical qualities of biscuits, such as their texture profile, proximate analysis, sensory attributes, and physical characteristics. The same ingredients used in preparing homemade crepes were also used in the seaweed crepe recipe. Nevertheless, more of *Eucheuma cottonii (E. cottonii* varies the

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ingredients' amount and ratio, including cottony seaweed powder. Significant changes were made to the physicochemical properties of the crepe formulation by adding powdered seaweed. Adding seaweed flour to the crepe's recipe also impacted the crepe's appearance, taste, consistency, sweetness, and aroma. This study aims to investigate the culinary potential of seaweed flour and offer a nutrient-rich substitute for regular crepe flour.

Keywords: Euchuema; seaweed crepe; seaweed flour.

1. INTRODUCTION

Food is consumed nowadays to satisfy hunger, provide nutritional facts, and lower the risk of illness [1]. These days, people read the ingredients list of every food product they purchase and consume [2] and try to follow it [3]. Many food products with health benefits and diets beyond basic nutrition have been introduced in response to public demand [4]. Thus, one of the fastest-growing areas of food product development worldwide is the creation of functional foods [5].

Due to safety concerns, people have a particular preference for functional foods that contain natural active ingredients [6]. Given that marine foods, particularly seaweeds, are the richest source of nutrients and are therefore beneficial to diet and health [7] and have economic value for the food industry, they are strongly advised to be used in commercial functional foods [8].

One of the common seaweeds found in our country, especially here in the Philippines [9], is the Eucheuma, also known as sea moss or guso, a rhodophyte seaweed found in many different colors [10]. Eucheuma species are used as a food source and as an ingredient in carrageenan, which is used in food processing and industrial manufacturing [11].

By creating products that have been processed, seaweed can be used to its fullest potential in terms of both economic and use value. Making flour out of seaweed as a Crepe ingredient is one attempt to develop it [12]. Among other nutrients, seaweeds are rich in dietary fiber, vitamins, minerals, and protein. Sterols, polyphenols, and polysaccharides are some of the bioactive compounds found in seaweed that are primarily responsible for its health benefits [13].

Furthermore, dietary fiber is essential to human nutrition because of its numerous health benefits [14]. Regularly consuming foods high in dietary fiber can reduce the risk of developing cancer, constipation, and heart attack, among other illnesses [15]. Min Huang and Hongshun Yang (2019) found that substituting Eucheuma powder for flour up to 10% of the time was acceptable [16] and helpful in raising the amount of dietary fiber consumed [17]. The researcher has read a study by Min Huang and Hongshun Yang from 2019, which stated that a new product with a high dietary fiber content was developed using Eucheuma flour instead of cake flour [18]. Past studies on Euchuema cottonii have mostly focused on its applications in cakes [19], biscuits, and muffins [20]. However, no specific research has been done on using Euceuma cottonii flour for crepes [21].

2. REVIEW OF RELATED LITERATURE

Early studies on Eucheuma Cottonii focused on its fundamental characteristics and initial applications in food science [22]. Researchers explored its role as a functional food ingredient, underscoring its nutritional value and potential in food product enhancement [23]. Pioneering work in integrating seaweed into bakery products highlighted its health benefits and feasibility in common food items [24]. These initial studies provided a crucial understanding of seaweed's properties [25] and laid the groundwork for its innovative applications in food technology [26].

Subsequent research expanded on these foundations, exploring Eucheuma Cottonii's incorporation in various food products like cakes and biscuits [27]. This phase marked a progression in enhancing the nutritional profile of everyday foods using seaweed flour [28]. Researchers also began examining sensory and textural modifications in food products due to seaweed flour [29], encountering both challenges and successes [30]. Significant advancements in processing techniques further characterized this phase [31], marking a shift towards specialized applications of seaweed flour in food technology [32].

Recent studies have focused on the innovative use of Eucheuma Cottonii in crepe production [33]. Current research fine-tunes the application of seaweed flour in terms of taste, texture [34], and nutritional value, prioritizing consumer acceptance [35]. Groundbreaking findings and novel applications have emerged [36], highlighting the recent advancements in technology and methodologies [37]. These studies hint at future directions in seaweed research, underscoring the potential implications of such innovations in advancing the field [38].

The literature review in this manuscript methodically charts the research journey of Eucheuma Cottonii, starting from initial studies that explored its basic properties and nutritional potential in food science [39]. It then transitions to exploring the integration of seaweed flour into various food items, focusing on sensory and textural improvements [40]. The culmination of this research trajectory is seen in recent innovative applications, particularly in crepe production, where the emphasis is on optimizing flavor, texture, and consumer appeal [41]. This historical research progression sets the stage for the current study's focus on employing Eucheuma Cottonii in crepe production [42], showcasing its relevance and novelty in the field [43].

3. MATERIALS AND METHODS

3.1 Collecting Seaweeds and the Processing

In October 2023, samples of sea moss, or Guso-Euchuema cottonii, were gathered from Surigao City, Surigao del Norte. The seaweed (E.cottonii) was thoroughly cleaned and rinsed with fresh water to get rid of the salt water. It was then immersed deeply for an entire night. Seaweeds were then dried for 24 hours at 40 degrees Celsius in tray dryers, and they were subsequently kept at room temperature in airtight containers. The dried seaweeds were ground into a powder using a hand grinder. Once sieved, this powdered seaweed was stored at room temperature in an airtight container for future use.

3.2 Crepe Ingredients

150g of wheat flour (4% carbohydrate, 9% protein),40g of unsalted butter (brands Buttercups, 83% fat, and 1.4% protein), 350 ml low-fat milk, 2 eggs, 2 tbsp white sugar.

3.3 Formulation of Seaweed Crepes

In Table 1, Three different formulations of seaweed crepe combination from seaweed powder (10-20%) with all-purpose flour and one control sample of crepe formulation were prepared.

3.4 Seaweed Crepes Preparation

Using an electronic balance, all of the necessary ingredients—all-purpose flour, seaweed powder, white sugar, eggs, and unsalted butter—were weighed in Table 1. We combined dry ingredients in various ratios, the seaweed powder and all-purpose flour. After beating the eggs, whisk them until the yolk and whites are well blended. After the butter had softened, the beaten egg, the white sugar, and the dry ingredients were added. Mix thoroughly in one direction until the desired batter is reached. Heat 1 tbsp of unsalted butter in a pan on medium heat and add a ladle of batter. To ensure consistency, evenly spread the batter. Cook the crepes with different ratios, as specified in Table 1, one at a time until both sides achieve a light golden color. Note the differences in each ratio.

3.5 Quality Analysis

The characteristics of a crepe, such as color, sensory, calory, and proximate analysis, were determined in the article Implementation of Statistical Quality Control (SQC) As a Quality Damage Control for Crepes Products in the Indonesian Food Industry by Y B Pramono et al 2023 IOP Conf. Ser.: Earth Environ. Sci. 1246 012048. DOI 10.1088/1755-1315/1246/1/012048.

Table 1. The composition of seaweed (*E. Cottonii*) crepe

Samples	A	B	C	Control
Wheat Flour (g)	135	127.5	120	150
Unsalted butter (g)	100	100	100	100
White sugar (g)	50	50	50	50
Seaweed powder (g)	15 (10%)	22.5(15%)	30(20%)	0(0%)

4. RESULTS AND DISCUSSION

4.1 Texture Analysis

The texture analysis results for the various formulations of seaweed crepe are displayed in Table 2. The experimental texture analysis data showed that the texture characteristics of the crepe, including the hardness parameter, were not significantly affected by the seaweed powder. The trend level of hardness for seaweed crepe increased significantly when the percentage of seaweed powder in crepe was increased, though slightly lower than for the control samples. The crepe with 20% seaweed powder (sample C) required the most force to compress because the addition of seaweed powder increased the crepe density and reduced the number of air pockets, which increased the force required for compression and consequently led to a decrease in crepe volume.

Table 2. Texture or hardness analysis result

Sample	Level of Hardness (g)
Control	923.00 ± 185.06^{a}
A	733.50 ± 194.30^{a}
B	789.17 ± 122.86^{a}
C	807.50 ± 235.36^{a}

4.2 Height and Weight of crepes

As indicated by Table 3, the height of the baked crepe samples increased. Still, there was no discernible change in the samples' Weight before and after cooking. The reason for the spread and expansion of the crepe during cooking is that a temperature difference caused the fat from the butter and sugar in the batter to make a soft pan. For this reason, seaweed powder did not alter the variations in crepe height before and after cooking.

4.3 Color Analysis

Given its influence on consumer preference, color seems to be a component of products' initial acceptability by consumers. Table 3 displays the color parameters of the crepe's crust and crumb. The color of the crepe was influenced by the seaweed powder used as a replacement for wheat flour in the recipe. The color data showed that as seaweed powder was added to the formulations, the L* value rose. Specifically, the crust lightened when seaweed powder was added in place of more wheat flour. Gomez et al. (2007) claim that the caramelization of sugars and the Maillard reactions between sugars and amino acids during baking give crepes their crust color.

As a result, the variations seen with increased seaweed powder quantity may be related to the composite flours' differing amino acid composition ratio and lower protein content. The greenness (a*) and yellowness (b*) decreased with an increase in the percentage of seaweed powder. Adding seaweed powder to the crepe crumb about the control sample resulted in an increase in the a* value and a decrease in the L* and b* values, respectively. According to Gomez et al. (2007), the low temperature prevented the crumb from entering the Maillard and caramelization stages.

Since the crumb does not reach as high a temperature as the crust, Sabanis et al. (2009) showed that while the crumb color is not affected by temperature, it may be influenced by the color of the substituted flour. The color of the ingredients used in the formulation is primarily responsible for the color changes. The color of the crepe crumb improved when the amount of seaweed powder was increased. Because of this, the protein content had a greater effect on the color of the crumb; crepes with the most seaweed powder had the darkest crumb, while those with the least seaweed powder had the lightest crepe crumb.

4.4 Protein Analysis

Protein is one of the components found in seaweed. The proportion of protein extracted from the E. is based on the experiment's outcome. 1.9% of the seaweed's total dry Weight was protein in the powdered cottonii seaweed. According to Harnedy & FitzGerald (2011), the average protein content of seaweed varied from 1 to 47% of the seaweed's total dry weight, depending on the species. In conclusion, the experiment's seaweed percentage fell within the range Harnedy & FitzGerald (2011) gave, indicating that the outcome was satisfactory.

4.5 Moisture Content

The moisture content of the crepe samples ranged from 1.40 to 2.04%; sample C, which contained more seaweed powder (20%), had the highest moisture content (Table 5). This result was anticipated due to the well-known ability of seaweed (hydrocolloids) to retain water. The current study's result was lower than Jenifer and

Kanjana's (2018) result, which showed that the 30% seaweed powder's moisture content was 2.34%.

4.6 Sensory Evaluation

Most panels award the control sample the highest marks compared to other formulations of seaweed crepe samples based on the average total score from the hedonic rating scale (Table 6). Nonetheless, the panels awarded the formulation crepe with 10% seaweed powder, the highest rating compared to other formulations of seaweed crepe samples. Table 6 shows that, compared to female panels, most male panels score higher on the appearance, color, and texture of seaweed crepe; however, they score lower on aroma, taste, and sweetness. Furthermore, many panelists felt uncomfortable chewing seaweed crepes containing 20% seaweed powder (sample C). However, overall, the panelists' feedback was positive, and most chose formulations with 10% seaweed powder (sample B) as the preferred version over the other formulations.

Table 3. Height and weight results before and after cooking

Sample	Height (mm)		Weight (g)	
	Before	After	Before	After
Control	8.09 ± 0.03	10.11 ± 0.06	6.71 ± 0.10	6.79 ± 0.13
A	8.07 ± 0.03	10.07 ± 0.05	6.64 ± 0.11	6.67 ± 0.10
B	8.06 ± 0.04	10.05 ± 0.05	6.62 ± 0.09	6.65 ± 0.12
C	8.07 ± 003	10.06 ± 0.08	6.65 ± 0.11	6.67 ± 0.13

Values are presented as mean $\pm SD, n = 3$

Table 4. Color analysis result

Sample	$\mathbf{L}^*$	$\boldsymbol{a}^*$	$\mathbf{b}^*$
Control	60.29 ± 1.90^{a}	$+7.50 \pm 0.30^{a}$	$+24.58 \pm 1.53^{a}$
A	$55.10 \pm 1.23^{a,b,c}$	$+7.01 \pm 0.17^{a}$	$+20.32 \pm 0.60^{a,b,c}$
B	$55.11 \pm 1.84^{\mathrm{b,c}}$	$+6.11 \pm 0.12^{\mathrm{b,d}}$	$+19.95 \pm 1.53^{b,c}$
C	50.05 ± 1.59^{c}	$+5.46 \pm 0.06^{c,e,f}$	$+19.93 \pm 1.42^{\mathrm{c}}$

Values are presented as mean $\pm SD, n = 3$

Table 5. Moisture content result

Sample	Moisture Content (%)
Control	$1.46 \pm 0.08^{\mathrm{a,c}}$
A	$1.40 \pm 0.06^{\mathrm{a,b}}$
B	$1.78 \pm 0.06^{\mathrm{b,c}}$
C	$2.04 \pm 0.27^{\mathrm{c,d}}$

Table 6. Sensory Evaluation Result

Sample	Gender	Average Total Score					
		Texture	Color	Aroma	Taste	Sweetness	Appearance
Control	Female	4.49	4.56	4.57	4.69	4.37	4.53
	Male	4.51	4.59	4.27	4.66	4.26	4.69
A	Female	4.44	4.37	4.49	4.6	4.33	4.41
	Male	4.41	4.34	4.29	4.49	4.22	4.47
B	Female	4.24	4.25	4.26	4.32	4.25	4.36
	Male	4.17	4.29	4.23	4.31	4.19	4.42
C	Female	3.98	4.22	4.15	4.1	4.14	4.12
	Male	4.03	4.27	4.09	4.06	4.06	4.19

5. CONCLUSION

Eucheuma powder demonstrated high levels of dietary fiber and ash and high levels of water and oil absorption capacity in the current study. It emphasizes that the batters' viscosity, velocity, and viscoelasticity were all increased when Eucheuma powder was substituted for flour in the crepe recipe. The crepes' texture and crumb color were altered by adding Eucheuma powder. However, the crepe with 5% and 10% Eucheuma showed no visible changes. The conclusion of this study emphasizes that the incorporation of Eucheuma Cottonii seaweed flour significantly influences the properties of crepes, as evidenced by the detailed results and discussions. The variations in texture, color, and sensory attributes across different seaweed flour percentages are highlighted. Furthermore, the study underscores the potential of seaweed crepes as a nutritious alternative to traditional crepes, reflecting a successful integration of health and taste. This research contributes valuable insights into the use of seaweed flour in food products, opening avenues for further innovative culinary applications.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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