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Development of dried seaweed (eucheuma) chips enriched with mango puree

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Abstract

Seaweed (Eucheuma) is one of the most abundant algae raw materials in the locality but have been underutilized for functional foods. Hence, the study utilized the Green Algae together with Mango Puree as an alternative Dried chip. Moreover, the conception of a new product will potentially contribute to the livelihood opportunities of the locals in the community. This study used the descriptive research method and purposively selected ten (10) respondents from the Food and Science Technology department of the University of Southern Mindanao – Kidapawan City Campus. Sensory evaluation was used with specific parameters to determine the overall product quality. A one-way Analysis of Variance (ANOVA) was utilized as a statistical tool. The results of the study revealed that the quality of the product of treatment three (3) was interpreted as satisfactory in terms of appearance, taste, and texture, and acceptable for the overall mean in the range of 3.83. There is no significant difference in the product quality of value-added dried seaweed chips in terms of appearance, taste, and texture. The ash content of the samples was found to be in the range of 6.86 percent (%); crude fat was found to be in the range of 13.23 percent (%), and moisture was found to be in the range of 22.80 percent (%). Moreover, the selection of the appropriate product packaging and further study on its shelf life is highly desirable to further optimize the product quality.

Keywords: Seaweeds, Mango-Puree, Value-Added, Food, Safety.

Introduction

Seaweed (Eucheuma) is mainly served as appetizers only, but it can also be developed into a more value-added product such as snack chips. It is highly beneficial to children and adults because these are easily consumable anywhere. They are also known as an excellent source of vitamins, especially for meatless diets because of its abundant in veggie protein, Vitamin B and K. It is also abundant in potassium, iodine, calcium, iron, and zinc, which are minerals concentrated in seawater. Sea veggies are high in vitamins, minerals, and dietary fiber while being low in calories[1].

Moreover, chips are heavy in fat and calories, which can contribute to weight gain and obesity. Additionally, majority of chips are deep-fried and salted, which produces trans fats. In another way, baked chips have less fat and calories than fried chips[2]. However, there is only a little-known study about how to increase the nutritional value of chips while still enjoying these snacks. Additionally, most people love to eat snacks especially chips without being aware of its nutritional value.

Moreover, the nutrient contents available in seaweed are ash, fat, and moisture. Also, seaweeds are also very potential to be developed into food products like chips[3]. Green Algae is highly abundant in the Philippines but with limited utilization. In fact, Green Algae is considered as the top aquaculture-produced species in the Philippines[4].

The researchers of this study sought to give significance to the edible seaweed, and in transforming it into chips – a product that many people love to eat. Moreover, there have been limited studies on the utilization of green algae as a functional food ingredient. Thus, the researcher explored the development of value-added dried seaweed chips, and determined the consumer acceptability of the product in terms of appearance, taste, and texture. Also, the researcher included the proximate analysis to guarantee that the products comply with applicable laws and legal declaration requirements, as well as the end product's safety when issued to the end user.

The general objective of the study was to determine the product quality of Value-Added Dried Seaweed Chips. Specifically, it aimed to: i. Develop value-added dried seaweed chips enriched with Mango Puree; ii. Determine the product quality of value-added dried seaweed chips in terms of Appearance, Taste and Texture. iii. Determine the significant difference on the product quality of value-added dried seaweed chips among treatment in terms of Appearance, Taste and Texture. iv. Determine the

proximate analysis on value-added dried seaweed chips in terms of moisture crude fat, and crude fiber.

The purpose of this study was to develop a value-added dried seaweed chips with a different formulation. This study would help students to venture into a new product recipe using seaweed that could help them gain extra income. The Philippines is abundant of edible seaweed, which is known as an appetizer. So, the researcher came up with the study using seaweed as the main ingredient. The results of the study would serve as baseline information for further product development innovation.

Materials and Methods

This chapter presents the Design Phase, which includes the Phase I product development, Phase II evaluation of consumer acceptability, and Phase III the proximate analysis. Phase I includes the sample preparation of value-added dried seaweed chips; phase II encompasses the appearance, taste and texture for sensory evaluation of the product quality; and phase III, the nutritional content evaluation in terms of ash, crude fat and moisture. Figure-1 show the schematic diagram of the study from product development to sensory evaluation and quality control analysis. Moreover, Table-1 and 2 shows the required ingredients and the different formulations. Table-3 listed the tools and equipments used in the study.

Table-1: Ingredients used in value-added dried seaweed chips.

Quantity	Unit	Description
400	Grams	Seaweed
160	Grams	White Sugar
128	Ounces	Purified water
60	ml	Mango puree

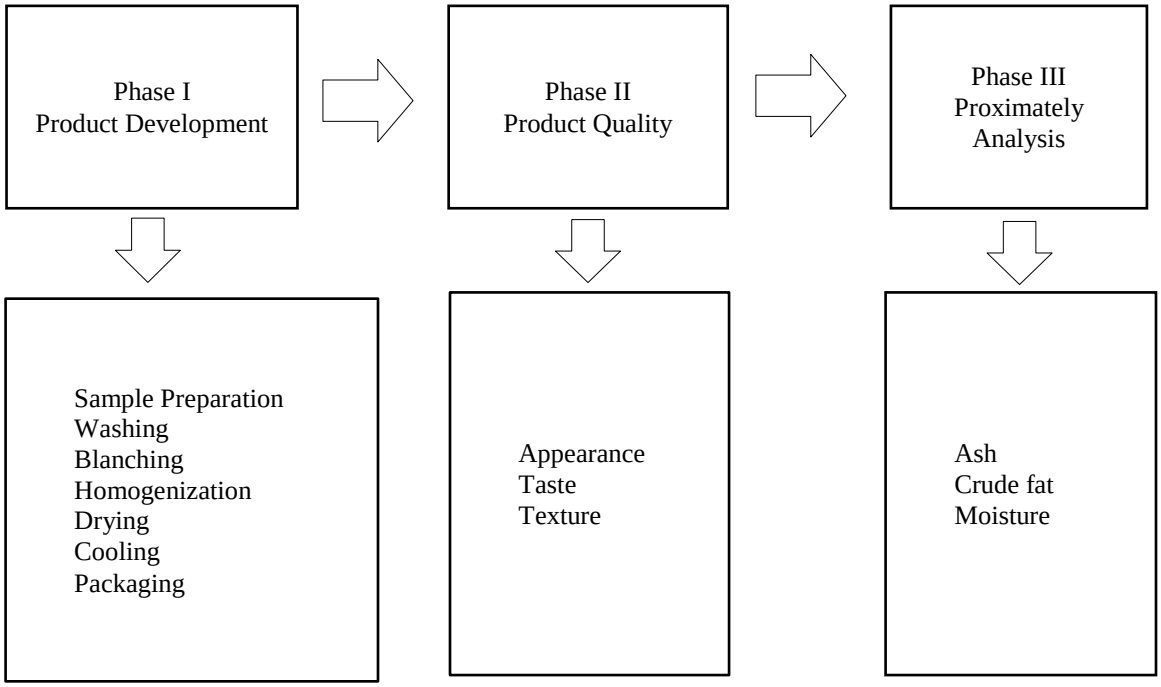

Figure-1: Concept Design of the Study.

Table-2: Formulations of value-added dried seaweed chips with Mango puree.

Ingredients	T1	T2	T3	T4
Seaweed	100 g	100 g	100 g	100 g
White Sugar	40 g	40 g	40 g	40 g
Water	20 g	20 g	20 ml	20 ml
Mango Puree	0%	10 ml	20 ml	30 ml

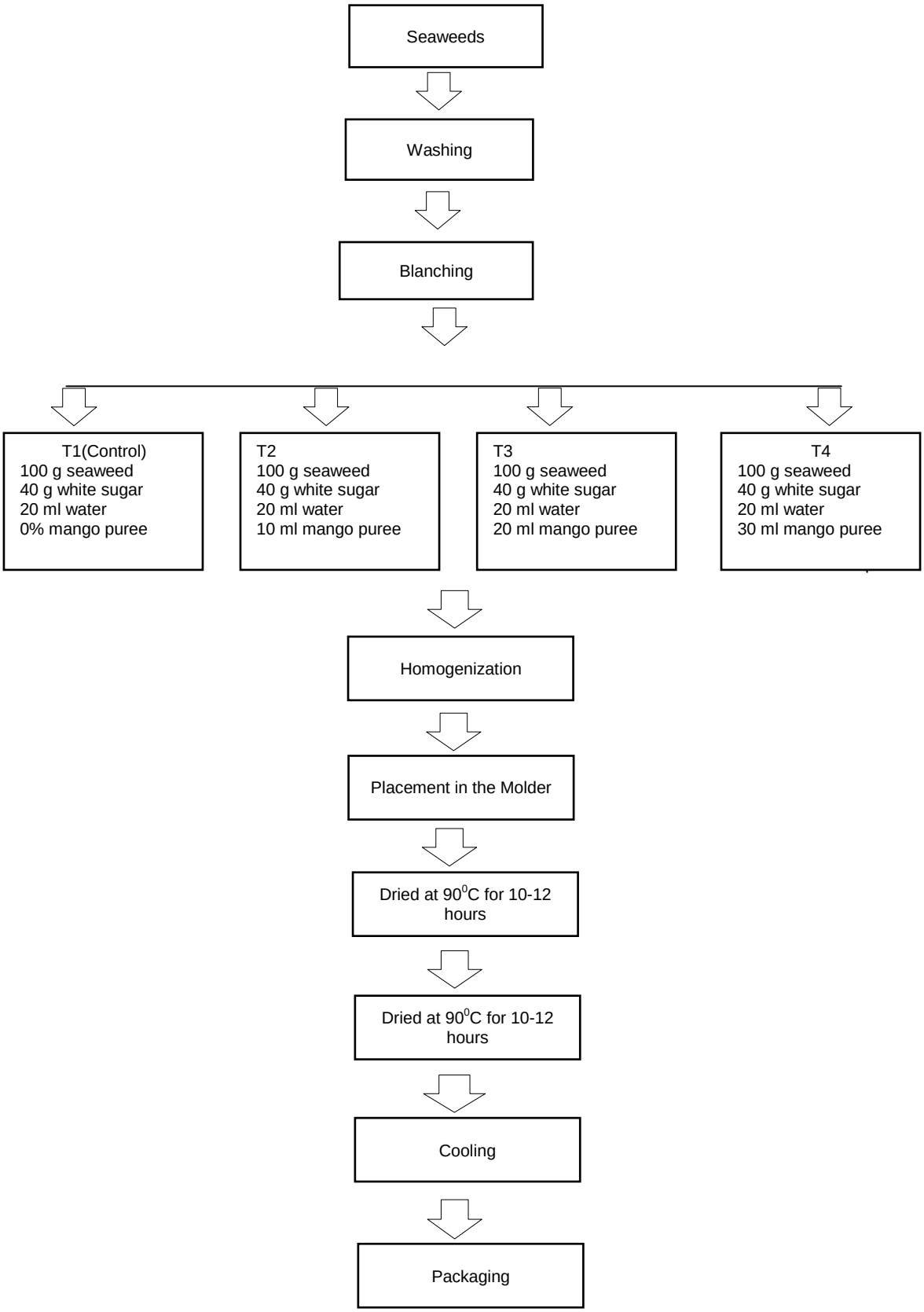

Figure-2: Processing Flow of Dried Seaweed Chipsenriched with mango puree.

Table-3: Tools and Equipment used in value-added dried seaweed chips.

Quantity	Unit	Description
1	Unit	Blender
1	Unit	Oven
3	Pcs	Graduated Cylinder
1	Set	Measuring Spoon
1	Set	Measuring Cup
2	Pcs	Stainless Bowl
1	Roll	Wax Paper
40	Pcs	Transparent Packaging

Preparation, Processing, and Development of Product Prototype: Figure-2 shows the general processes of the product development. The fresh seaweed was purchased from the local public market of Malita, Davao Occidental. The development procedure was performed at the Research and Laboratory Services Center (RLSC), SPAMAST, Malita Davao Occidental Philippines. The product prototype was prepared by washing the green algae (Eucheuma) with tap water to remove the foreign materials accumulated in the sample. The rinsed algae were soaked for 5 minutes with purified drinking water to remove the undesirable seawater odor accumulated. The soaked algae samples were blanched for 5-10 seconds to remove the natural microbe's inhabitance. After blanching, the algae were homogenized until all the samples were fully grinded together with sugar and mango meat. The homogenized algae and mango were then transferred to a molder with a size ranging from one to two centimeters. The algae were then dried in the oven at 90^0 Celcius for 10-12 hours or until the sample was fully dried. After the samples were taken out of the oven and set to cool for a while and packed into transparent packaging to maintain the product integrity. Samples were collected for sensory evaluation and for proximate analysis.

Evaluation Phase: Research Instrument: The researcher used an adapted and modified questionnaire from the study of Ranganna[5] to conduct the sensory evaluation such as appearance, taste, and texture.

Moreover, a sensory evaluation score sheet was used to evaluate the four treatments. The score sheet contained five rating scales to determine the product quality of value-added dried seaweed chips in terms of appearance, taste, and texture. The product quality of value-added seaweed chips was measured with the use of a 5-point Likert scale. Each sample was rated on a 5-point Likert scale which stands for Outstanding; 4 - Satisfactory, 3 - Good; 2 - Fair, and 1 - Poor. A portion at the bottom of the questionnaire was provided for the comments and suggestions for further improvement of the project.

The respondents rated the sample and encircled the number which conforms to the rating appropriate to the Likert scale presented.

Table A shows the criteria and interpretation for product quality of value-added dried seaweed chips in terms of appearance.

Respondents of the Study: The respondents of the study were the ten (10) faculty members of College of Technology. Purposive sampling was used to determine the respondent of the study. They were selected to determine the overall product quality for sensory evaluation in terms of appearance, taste, and texture of value-added dried seaweed chips. The sensory evaluation was performed using the modified Likert scale protocol of Watts et al.[6].

Sensory Evaluation of the Product Prototype: The researcher prepared different treatments of product prototype. The researcher sought the approval of the selected respondents, after which the researcher distributed the score sheet and explained how to evaluate the product quality. The sample of each treatment was evaluated by the respondents of the study. The products are labeled as follows treatment one (1) constitute the 100grams' seaweeds, 40grams' sugar, 20ml water meanwhile treatment two (2) 100grams seaweeds, 40grams sugar, 10ml mango puree and 20ml water, the treatment three (3) consist of 40grams seaweeds, 40grams sugar, 20ml mango puree and 20ml water and lastly the treatment four (4) has the following formulation; 100grams seaweeds, 40grams sugar, 30ml mango puree and 20ml water.

Evaluation of the Proximate content: Proximate analysis of treatment samples was carried out at University of Southern Mindanao Agricultural Research Development Center (USMARDC) Kabacan, Philippines. The test analyses samples were tallied according to its result. Proximate analysis was carried out according to the procedure of Association of Official Analytical Chemists[7] for Ash, moisture, and crude fat content.

Statistical Treatment and Analysis of Data: A frequency count and weighted mean were used to determine product quality. A one-way Analysis of Variance (ANOVA) was utilized as a statistical tool to compare the significance of the four treatments.

Results and Discussion

This chapter presents the results of the sensory evaluation and proximate analysis of the of value-added dried seaweed chips enriched with Mango puree. Table-4 shows the rating result in terms of appearance to the three treatment groups. Treatment three (3) has a mean rating of 3.40, which means that the product is moderately attractive in color and shape and can be described as Satisfactory. Moreover, Treatment two (2) got a rating of 2.80 which means that the product is slightly attractive in color and shape, and described as good, while treatment four (4) has a mean rating of 3.10, which means slightly attractive in

color and shape, and has good attributes of appearance. The results show that treatment three (3) got the highest result in terms of appearance compared to other treatments. According to Wendin and Undeland[8] the color and shape of different snack chips, cookies and candy contributes significantly to the appeal of the product to the consumers.

Table-5 shows the rating of the sensory evaluation result in terms of Appearance, taste, texture and Overall quality to the different treatment groups. Treatment 1 represents the control group with no added Mango puree. Treatment 2, 3 and 4 has added 10ml, 20ml and 30ml Mango puree. Moreover, all treatments have equal quantity of Seaweeds, Water and Sugar.

The Treatment three (3) got the highest rating of 3.90 which means that the "product is sweet" which is described as "Satisfactory", and treatment four (4) with a rating of 3.50 which is "slightly sweet and slightly not blend" which is described as "Good", and treatment two (2) has a rating of 3.30 which is "slightly not sweet and slightly not blend" which is described as "Fair".

Table-4: Sensory Evaluation Ratings of value-added dried seaweed with Mango puree.

Product quality	Treatment	Mean	Description
Appearance	1	2.700	Fair
	2	2.800	Good
	3	3.400	Satisfactory
	4	3.100	Good
Taste	1	3.100	Good
	2	3.300	Good
	3	3.900	Satisfactory
	4	3.500	Good
Texture	1	3.000	Good
	2	3.200	Good
	3	4.200	Satisfactory
	4	3.500	Good
Quality (Overall)	1	2.934	Good
	2	3.100	Good
	3	3.834	Satisfactory
	4	3.366	Good

Moreover, almost all of the respondents rated that the product was sweet, which is generally regarded as satisfactory. This confirms the products sweetness. Moreover, sweetness of the product contributes the uniquely desirable property of the product[9].

In terms of texture, Treatment three (3) has a rating of 4.20 which means that the product is "satisfactory" characterized by "dry and moderately moist surface" and treatment four (4) got a rating of 3.50 which means that "the product has slightly moist surface" which is described as "Good". Lastly, treatment two (2) got a rating of 3.20, which means that the "product has slightly moist surface" which is described as "Good". Most of the respondents rated the product dry and moderately moist, which is described as satisfactory. Further implied that product has been dried evenly. Moreover, uniform and properly dried products will have better overall texture.

Table-6 shows the statistical implications of the ratings of the sensory evaluations. In terms of overall product quality, the rating of the various treatments was statistical determined using the sensory evaluation results. There are significant differences between the four treatments.

The results revealed that the computed f-value for the product quality of value-added dried seaweed chips in terms of appearance is 5.15. Since the d-value of 0.005 is less than 5% of significance, this denotes that there is a significant difference between the four treatments in terms of appearance because the added mango puree may change the characteristics of the product. Thus, the null hypothesis which states that "there is no significant difference between the four treatments" is rejected.

Meanwhile, the results for the product quality in terms of taste revealed that the computed f-value is 3.39. Since the d-value of 0.028 is less than 5% of significance, this means that there is a significant difference between the four treatments in terms of taste because a larger amount of mango puree added than the original could alter the flavor. Thus, the null hypothesis which states that "there is no significant difference between the four treatments" is rejected.

Table-5 statistical analysis shows that the result for the product quality in terms of texture revealed that the computed f-value is 10.24. Since the d-value of 0.015 is less than 5% level of significance, this connotes that there is a significant difference between the four treatments in terms of texture because the higher amount of mango puree added in the product may affect the characteristics of the samples. Thus, the null hypothesis which states that "There is no significant difference between the four treatments" is rejected.

Table-5: Statistical Significance of the Four Treatments of valued-Added Dried chips with Mango puree.

Product Quality	df	F-value	D- value	Decision
Appearance	3	5.14	0.005*	Reject Ho1
Taste	3	3.39	0.028*	Reject Ho2
Texture	3	10.24	0.015*	Reject Ho3

*-significant 0.05 level of significance.

The proximate analysis results of the four (4) treatments are shown in Table-9, 10, 11, where analysis constitutes the Moisture %, Fat % and Ash %. Treatment four (4) has the highest moisture with 22.80, followed by treatment three (3) with 19.8; then treatment two (2) has 17.4, while treatment one (1) has the lowest moisture with 14.8. In terms of fat, treatment three (3) has the highest fat content with 13.23, followed by treatment two (2) and treatment four (4) with 12.74 and 12.72, respectively; meanwhile, treatment one (1) had the lowest fat with 9.76. Moreover, in terms of percent five (5) ash, treatment three (3) has the highest with 6.86, followed by treatment two (2) and treatment four (4) with 5.89 and 5.53, respectively; while treatment one (1) has the lowest with 4.69.

Moreover, based on the acceptability and proximate analysis, treatment three (3) which constitutes 100gram seaweeds, 40grams sugar and 20grams Mango Puree and 20ml water, is favored to have the best formulation of Dried Seaweed Chips. It implied that the product quality and the proximate analysis of treatment three (3) was accepted in terms of ash, fat, and moisture.

On the other hand, the purpose of the analysis is to guarantee that customers are fully educated on the nutritional composition of goods so that they can make informed and competent diet decisions[10].

Table-6 shows the results of proximate analysis in terms of Ash, Fat and Moisture. The ash level of a product is determined as part of the proximate analysis for nutritional evaluation and is an important quality attribute for specific food ingredients[11]. In addition, based on the results, treatment three (3) had the highest ash content with 6.86, closely followed by treatments 2 and 4 with 5.89 and 5.53, respectively.

Ash content is a positive indicator of the high content of minerals present in Value Added Dried Seaweed chips. Secondly, the crude mixture of fat-soluble substances present in a sample is referred to as crude fat. It is the standard measure of fat in food products and is also known as the ether extract or the free lipid content. Fat has a high efficiency as a food because the fat in food is almost fully reabsorbed by the body[12].Based on the results, treatment three (3) had the highest fat content with 13.23, followed closely by treatments two (2) and four (4) with 12.74 and 12.72, respectively. Meanwhile, treatment one (1) has the lowest fat content with 9.76.

Moreover, the moisture content is one of the parameters assessed in the proximate analysis. Moisture is a measurement of the total amount of water in a food product, which is usually represented as a percentage by weight on a wet basis. To prevent microbial growth, the moisture content and water activity must be kept below 10% and 0.60–0.65, respectively[13]. In addition, based on the results of the moisture content, the treatment one (1) has the lowest moisture content, which is probably due to lack of addition of mango puree. Provided with the same temperature and time of drying, the pure dried seaweed chips can easily lose the moisture compared to the other treatments which were added with a specific amount of mango puree.

Table-6: Laboratory Result of the Proximate Analysis of Value-Added Dried Seaweed Chips with Mango puree.

Analysis	T1	T2	T3	T4
Ash (%)	4.69	5.89	6.86	5.53
Fat (%)	9.76	12.74	13.23	12.71
Moisture (%)	14.8	17.4	19.8	22.8

Treatments: The study aimed to develop value-added dried seaweed chips blended with mango puree. Phase one (1) of the study focuses on the development of the product prototype, whereas four (4) treatments underwent processing. The prepared treatments had variations in terms of the quantity of mango puree, treatment one (1) was not blended with mango puree, treatment two (2) was blended with ten (10) grams; treatment three (3) with 20grams, while treatment four (4) with 30grams of mango puree. 40grams of sugar and 20ml of water were added in all treatments.

The quality of developed product prototypes was evaluated by ten (10) panelists from the Food and Science Technology department of the University of Southern Mindanao – Kidapawan City Campus. The panelists evaluated the product in terms of the following parameters, namely appearance, taste, texture, and overall quality. The panelists rated each treatment based on the Likert scaling, whereas five (5) is considered outstanding, four (4) satisfactory; three (3) good; two (2) as fair, while one (1) is rated as having a poor quality.

Based on the results, treatment three (3) got the highest rating in terms of appearance, taste, texture, and overall quality, obtaining a rating of 3.834 which is considered to have a satisfactory product quality. The results of the proximate analysis show that treatment three (3) has a higher ash content which is indicative of higher mineral content. Secondly, treatment three (3) has a higher fat content, which is 13.23.

Moreover, treatment one (1) has better moisture with 14.8. The results of the sensory evaluation and proximate analysis show that treatment three (3) which constitutes 100grams of seaweeds, 40grams of sugar, 20grams of mango puree, and 20ml of water, has better formulation. Hence, the study is able to establish the potential of seaweeds as viable material in processing dried seaweed chips.

Conclusion

The developed prototype of Value-added dried seaweed chips enriched with Mango puree shows a promising potential as snack chips. Sensory attributes have been shown to be

acceptable in terms of appearance, taste, texture, and overall quality.

Secondly, the study concludes that sensory evaluation of the different formulations shows that the treatment three (3) with 20 grams of mango puree has better quality in terms of appearance, taste, and texture.

Moreover, the results of proximate analysis of treatment three (3) shows higher mineral content as indicated by the higher ash content and has a significant amount of crude fat percentage.

The overall quality based on consumer acceptability and proximate analysis of the treatments shows an indicative potential of value-added dried seaweed chips as a new commercial snack.

Recommendations: The succeeding researchers who are eager to undertake further studies concerning the Value-Added Dried Seaweed Chips should take into account the following recommendations: i. Conduct a study on the evaluation of shelf life of value-added dried seaweed chips; ii. election of appropriate product packaging; iii. Further optimization of the overall product taste, appearance and texture.

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