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Improving Chinese Chives Recipe in Accurate Mixture of Riceberry Flour and Lettuce Seaweed

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Abstract

This experimental research developed Chinese chives recipe using riceberry flour enriched with lettuce seaweed. The study had three objectives: (1) to study riceberry flour content in Chinese chives production of 10%, 30% and 50% by weight, evaluated by 50 experts; (2) to examine the recipe developed to add lettuce seaweed at the amount of 0.1, 0.5 and 1.0 percent by weight; and (3) to analyze the quality of microorganisms and nutritional value of the product. The results were (i) the recipe mixture of riceberry flour 30% by weight received the highest overall liking score; (ii) the chives recipe mixture supplemented with lettuce seaweed 1.0% by weight received the highest overall liking score on texture and taste; and (iii) the total number of microorganisms was found at 2.8X103 colonies per 1 gram sample--in line with the community product standards. As for nutritional values, the new recipe developed proved to contain carbohydrates, dietary fiber, beta-carotene, magnesium, zinc, and essential fatty acids, including oleic acid and linoleic acid.

Keywords: *Chinese chives, riceberry flour, lettuce seaweed, product development*

1. Introduction

Today, changes in social factors apparently affect the global economy. Food manufacturers tend to boost their potential and improve in product research and development to increase production to meet the needs of consumers. Those changes are primarily caused by various factors, such as free trade and investment that can result in high competition. Hence, product development must comply with quality and quantity to attract attention, including production time which is another factor that needs to be given full attention to respond to consumer needs in a fast-paced society. Manufacturers and product developers have to work against time to develop interesting products that meet people's needs (Worasing, Sriveerachai, Srianant & Wongkang, 2009). According to the study by Fuller (1994), product development has many objectives with a wide coverage. However, the development aims to produce new profitable products for the survival of the organization. As West et al. (1991) noted, product development approaches for small businesses can take many forms, such as developing products that have never been produced or introduced to the market, including the development and release of the first products that the organization produces to stimulate consumer interest as well as developing new products with emphasis on the production process that the organization has selected for the new markets that the organization has never touched. In addition, (Katz, 1998) specified that certain products can be produced and marketed within a short time and quickly; therefore, the organization must be ready in terms of technology and knowledge about the production process, including all other matters related to the developed product.

Fishery and Agricultural Products:

Model Sea Farm Project under the Royal Initiative of Her Majesty Queen Sirikit is located at Tambon Bang Kaeo, Ban Laem District Phetchaburi Province arising from the initiative of Her Majesty Queen Sirikit to alleviate the problem of diminishing natural marine life in Thai waters, including fuel and other factors used to set sail to catch wild fish at higher costs--setting sail to catch aquatic animals in more distant seas, and yet aquatic animals caught are not worth the cost. The project mentioned above up serves as a source of education and exchange of knowledge on fisheries for farmers in order to develop suitable fishing careers (Department of Fisheries, 2019). It enables the people in fishing areas to carry out the activities that the project transfers in producing agricultural products from plant cultivation and animal husbandry in sufficient quantities to meet the market demand. More importantly, there is still a lack of fishery products that are sold to consumers and there are some raw materials from the sale of waste fishery products. Such products are in large quantities or cannot be sold are sea grapes as well as lettuce seaweed and riceberry flour, to name but the major ones.

Particularly, Lettuce seaweed is rich in various vitamins and minerals, such as vitamin B, vitamin C, calcium and iodine (Worasing, Sriveerachai, Srianant & Wongkang, 2009). As it is easy to digest and low in fat, it is suitable for those who want to lose weight. It has several properties that help treat osteoporosis, purify blood vessels, make blood vessels flexible, help reduce cholesterol, reduce blood pressure, treat constipation, heals stomach ulcers, stimulate the immune system, relieve rheumatism as a sedative and help eliminate some bacteria that can cause cancer. Moreover, lettuce seaweed has outstanding nutritional properties which are antioxidants, such as beta carotene, vitamin E, tannin, zinc, high folate and low sugar (Noppakonmongcon, Saenkla & Chaleawai, 2014). Considering the nutrients of lettuce seaweed, the researchers initiated a product of Chinese chives by using riceberry flour supplemented with lettuce seaweed to bring fishery products to increase value, reduce waste of agricultural products and create new processed products for farmers or people in Bang Kaeo Subdistrict, Ban Laem District, Phetchaburi Province.

This study aimed at the production of Chinese chives by using riceberry flour in an appropriate amount. The researchers examined the appropriate amount of Chinese chives using riceberry flour on lettuce seaweed, investigated chemical changes, microbes and nutritional value of Chinese chives using riceberry flour supplemented with lettuce seaweed. In line with these objectives, the researchers aimed at producing Chinese chives using riceberry flour and lettuce seaweed in an appropriate amount, while observing chemical changes, microbes and nutritional value of the newly developed Chinese chives recipe.

2. Materials and Methods

This study divided the experimental development of Chinese chives using riceberry flour supplemented with lettuce seaweed into 3 steps as follows:

2.1 A study on the production of chives recipe

In this step, the researchers studied the appropriate amount of riceberry flour in the mixture of Chinese chives. The ratio of riceberry flour to rice flour was at 3 levels of 10:90, 30:70 and 50:50 percent by weight. Then, the researchers chose the chives recipe using riceberry flour that has been recognized by the experts for the highest overall taste, texture and taste respectively.

2.2 A development of Chives recipe

In this step, the researchers developed chives using riceberry flour supplemented with lettuce seaweed in a proper ratio of mixture. The researchers examined the suitable amount of dried lettuce seaweed in the mixture at the amount of 0.1, 0.5 and 1.0 percent by weight. Sensory tests were conducted to select the chives recipe which receives the highest overall preference among the experts, texture and taste respectively.

2.3 An investigation of chemical changes, microbes and nutritional value of the Chives recipe developed

In this step, the researchers studied the microbial and nutritional changes of Chinese chives using riceberry flour supplemented with lettuce seaweed. The product was packed in a glass bottle and stored at room temperature for 4 weeks. The product was randomly sampled for analysis of microorganisms every 1 week to observe the nutritional value of chives products using riceberry flour supplemented with lettuce seaweed.

2.4 Chinese chives recipe and making

Riceberry flour 1.48%, Rice flour 3.25%, Chives leaves 59.17%, Tapioca flour 11.83%, Hot water 14.79%, Rice bran oil 6.80%, Salt 1.48%, Baking soda 0.60%, and Dried mustard seaweed 0.60%.

The steps in making Chinese chives recipe were: Combine riceberry flour, rice flour and tapioca flour, knead with hot water until well combined. Then add another part of rice bran oil and knead until the dough is smooth and well combined. Make the chives stuffing by putting the chives leaves, salt, baking soda and rice bran oil into a mixing bowl and knead until the ingredients are combined. Then squeeze out all the water. Add dried mustard seaweed. Set aside in the mixing bowl. Divide the dough into 15 grams per ball and form into balls, and roll to a thickness of 3 mm. Cover with a thin white cloth moistened with water. Then sort the rolled dough and wrap it with Chinese chives, 20 grams each, put it on a tray lined with wax paper and steam it. Set the crate over medium heat until the water boils. Steam the chives. Then turn on the heat and steam for

10 minutes. Put the crate down and set aside to cool the chives and then put into containers or served.

2.5 Preparation of lettuce seaweed

Bring lettuce seaweed to clean. Then dry in the sun. Put in the hot air oven for about 30 minutes or until the lettuce seaweed has less moisture. Then blend until fine powder.

2.6 Experimental planning and statistical analysis

The researchers studied the changes in Chinese chives using riceberry flour supplemented with lettuce seaweed, in a completely randomized design (CRD); two replicates were performed, and the mean was compared by Duncan's New Multiple Rang Test (DMRT) at 95% confidence level. The samples were collected at room temperature for 4 weeks and analyzed for microbial properties every 1 week.

The researchers used the water activity test analysis using aw meter for chemical properties. pH analysis was carried out using a pH meter and a microbial characterization test for total microorganisms according to the method introduced by BAM (2001, 2006) and ISO (2017), as well as the nutritional analysis according to the method by AOAC (2006, 2012, 2016, 2019)

As for sensory evaluation, the test was performed using a 9-point hedonic scale to evaluate color, smell, texture and overall preference. A randomized complete block design was conducted by 50 expert tasters (Sensory and Consumer Behavior Certificate). The mean differences were compared using Duncan's New Multiple Rang Test (DMRT) (AOAC, 2012) at 95% confidence level.

3. Results and Discussion

3.1 The production of chives from riceberry flour in an appropriate amount

From the preference test of 50 experts, tested by tasting, they were given a liking score using a 9-point hedonic scale (shown in Table 1). It was found that the chives products produced from rice flour to riceberry flour were 0 (control example) 10:90, 30:70 and 50:50. Percentage by total weight scores for color, odor, taste, texture and total likeness were different from the control formula statistically significant ($p<0.05$). Chives products (control sample) by weight, all received 7.36 points for color, 7.68 for smell, 7.88 for taste, 8.14 for texture and 7.98 for overall preference.

When considering the ratio of chives flour produced from riceberry flour to rice flour, the researchers found that an increase in the ratio of riceberry flour to rice flour resulted in a decrease in color, odor, taste and total preference scores. It was statistically significant ($p<0.05$), which the color score decreased in the range of 6.70 to 7.24 points, and the smell in the range of 6.82 to 7.52 points, while taste ranged from 6.78 to 7.82 points, texture from 6.96 to 7.98 points, and total overall preference from 6.90 to 7.82 points. The liking score evaluated by the experts was an indicator of the quality of the product acceptable to consumers (Abdi & Williams, 2010). The Chinese chives flour product produced from the ratio of riceberry flour to rice flour at the amount of 30 percent by total weight was found to have the same scores for taste, texture and overall preference as the control sample of Chinese chives flour statistically significant (p<0.05). However, when increasing the amount of riceberry flour in large quantities, the product's liking may decrease due to the texture of the product being hard. Consistent with the research of Klamklomjit, Wooti & Leelahapongstom (2022), who studied the product development of riceberry Cookie Stuffed with Pineapple, it was reported that when adding more riceberry flour, the product became more crumbly and less favorable to consumers.

Table 1: Results of the Expert's Liking Test Scores on the Characteristics of Chives Using Riceberry Flour over Rice Flour

Sensory features	Chinese chives ratio of riceberry flour to rice flour (Percentage of total weight)			
	Control sample	**10**	**30**	**50**
Color	7.36 ± 0.80^{a}	7.24 ± 0.74^{ab}	7.04 ± 0.28^{b}	6.70 ± 0.70^{c}
Smell	7.68 ± 0.84^{a}	7.52 ± 0.86^{ab}	7.24 ± 0.66^{b}	6.82 ± 0.75^{c}
Taste	7.88 ± 0.92^{a}	7.82 ± 0.94^{a}	7.60 ± 0.93^{a}	6.78 ± 0.71^{b}
Texture	8.14 ± 0.81^{a}	7.98 ± 0.91^{a}	7.82 ± 0.98^{a}	6.96 ± 0.86^{b}
Overall preference	7.98 ± 0.77^{a}	7.82 ± 0.85^{a}	7.66 ± 0.89^{a}	6.90 ± 0.81^{b}

*Different characters of a-d on the same horizontal line indicates significant difference (p<0.05).

When considering the ratio of riceberry flour to rice flour suitable for the production of chives from the formula that receives the highest overall liking score, they were particularly texture and taste, respectively. From the evaluation of sensory quality in terms of such preference, the researchers, therefore, decided to choose the ratio of riceberry flour to rice flour equal to 30 percent of the total weight. The experts gave it the highest score for smell, taste, texture and overall liking. Therefore, chives using riceberry flour were selected to be substituted for rice flour equal to 30 percent of the total flour weight to be examined in the next part.

3.2 Chives using riceberry flour supplemented with an appropriate amount of lettuce seaweed

When riceberry flour at the ratio of 30: 70 to rice flour was added to lettuce seaweed at the amounts of 0.1, 0.5 and 1.0 percent by weight, it showed the appearance as shown in Figure 1.

Figure 1: Chives from Riceberry Flour with Lettuce Seaweed at the Amount of 0.1 (A), 0.2 (B) and 1.0 (C) Percent by Weight


(A) (B) (C)

The experts' preference test scores were obtained by tasting and rated their liking on color, smell, taste, texture and overall liking (shown in Table 2). It was found that when increasing the amount of lettuce seaweed, the panelists scored a statistically significant difference in sensory preference from the control sample ($p<0.05$). However, the control sample received liking scores for color, odor, taste, texture and overall liking of 7.52, 7.00, 7.83, 7.36 and 8.67, 4.52 points, respectively, while the liking score for taste and texture preferences were not significantly different from the control samples ($p<0.05$). The Carissa Carandas products are usually sensory tested for appearance, color, and overall preferences of experts, as reported by Srimongkollak & Lekwat (2023) of no statistical difference in the sensory characteristics.

When considering chives recipe mixture of riceberry flour as a replacement for rice flour supplemented with lettuce seaweed in the amounts of 0.1, 0.5 and 1.0 percent by weight, the panelists rated color sensory preference and the odor aspect with significant difference ($p<0.05$), by which the color scoring in the range of 6.25-7.58 and the odor in the range of 6.57-7.00. However, the scores on taste, texture and total liking were not significantly different when adding lettuce seaweed in riceberry flour as substitute products by which the score was in the range of 7.50-7.52 points, the texture in the range of 7.00-7.52 points, and the overall preference in the range of 7.35-7.92 points. The preference scores of the experts indicated the quality of the product acceptable to consumers (Abdi & Williams, 2010).

Table 2: Expert Preference Scores on Product Characteristics

Sensory features	Chives products using riceberry flour to replace rice flour amount of lettuce seaweed			
	Control sample	0.10	0.50	1.00
Color	7.52±0.52[a]	7.00±0.00[a]	7.58±0.67[a]	6.25±0.46[b]
Smell	7.00±0.60[a]	7.00±0.60[a]	6.42±0.52[b]	6.57±0.89[b]
Taste[ns]	7.83±0.57	7.52±0.62	7.67±0.49	7.50±0.54
Texture[ns]	7.36±0.50	7.45±0.52	7.00±0.89	7.00±0.89
Overall preference	8.67±0.49[a]	7.92±0.52[b]	7.57±0.62[b]	7.35±0.92[b]

*a-c means different characters on the same horizontal line which were significantly different ($p<0.05$).
[ns]means no statistically significant difference ($p<0.05$)

As reported, the selection of lettuce seaweed quantity added in chives using riceberry flour was based on the formula with the highest overall liking scores, maximum texture and the highest taste, respectively. As for chives using riceberry flour and lettuce seaweed supplement, 0.1 percent per weight, the experts rated overall favorability, texture and high taste. It was not different from Chinese chives using riceberry flour supplemented with lettuce seaweed in the amounts of 0.1 and 0.5 percent per weight. Therefore, the researchers chose the Chinese chives using riceberry flour in which lettuce seaweed was added at 0.1 percent per weight for further studies.

3.3 Chemical changes and microbes and the nutritional value of Chinese chives

The researchers examined the shelf life of Chinese chives using riceberry flour supplemented with lettuce seaweed. The total number of microorganisms, yeasts and molds were analyzed, as well as the nutritional value of chives using riceberry flour supplemented with lettuce seaweed. The results were as follows:

Chemical and microbial quality analysis of Chinese chives from riceberry flour supplemented with lettuce seaweed

From the analysis of microbial quality of riceberry flour added to the products with lettuce seaweed (shown in Table 3), which is a chemical and microbiological quality check after the production process to indicate hygiene in production, including the quality of raw materials. Such quality can affect contamination of Water Activity equal to 0.87 because the Water Activity value is a factor indicating the lowest level of water in food that microorganisms can be used to grow and use in various chemical reactions. Almost all bacteria are unable to grow at water activity below 0.9 and most fungi do not grow at water activity below 0.7; the pH of the experimented product was 5.51 (Dangjai & Wogndomai, 2019). In addition, the community product standards (CMU 1041/2548) (Anonymous, 2022: Rice Flour Stuffed with Chinese Chive) of Chinese chives indicate that Microbial standards, i.e., the total number of microorganisms must not exceed 1 x 106 colonies per 1 gram of sample. From the analysis under study, it was found that

Chinese chives made from riceberry flour added with lettuce seaweed, the total number of microorganisms was found to be 2.8 x 103 colonies per 1 gram of sample, indicating that the product of Chinese chives developed, comply with the community product standards.

Table 3: Analysis of Water Activity, pH of Microorganisms, Yeast and Mold during Product Storage

Quality value	Number of microorganisms
Water Activity (a_w) at 25ºC	0.97
pH	5.51
Aerobic Plate Count, cfu / g	2.8×10^3
Yeasts and Molds, cfu / g	< 10

Nutritional value of the Chinese chives developed

Based on the nutritional value analysis, the Chinese chives developed by a new formula contained the content of protein, fat, ash, total carbohydrates, total dietary fiber and total amount of energy. The amount of energy from fat, vitamin A (beta-carotene), magnesium, zinc, sodium was found with high nutritional value. As for nutritional values per 100 grams, the product contained 2.67 grams of protein, 3.99 grams of total fat, 25.56 grams of total carbohydrates, 147.63 kcal of energy, 35.91 kcal of energy from fat, 4.00 grams of total dietary fiber, beta-carotene 2, 812 micrograms, magnesium, 48.42 micrograms, zinc 0.05 milligrams, and sodium 225.06 milligrams. In addition, the experimental results showed Chives rich in dietary fiber and as source of be-ta-carotene and iron. As for lettuce seaweed, there were nutrients beneficial to the body, as reported earlier by Worasing, Sriveerachai, Srianant & Wongkang (2009) who analyzed the chemical composition of lettuce seaweed and found lettuce seaweed with protein, dietary fiber, calcium, sodium in the amount of 23.0 percent, 9.97 percent, 38.8 percent, and 21.8 percent, respectively. In addition, from the research of Yuenyongputtakal, Worasing & Noyphan (2019), lettuce seaweed when added, would result in the product having a high amount of protein, fat and antioxidant properties.

Table 4: Analysis of Nutritional Values of Chinese Chives Using Riceberry Flour with Seaweed Lettuce

Nutritional value	**Quantity**
*Protein (g/100 g)	2.67
Total Fat Content(g/100g)	3.99
Ash (g/100 g)	1.90
Carbohydrates (grams/100 grams)	25.56
total energy (kcal/100 g)	147.63
energy from fat (kcal/100 g)	35.91
Total dietary fiber (g/100 g	4.00
Beta Cartine (mcg/100g)	2,812
Magnesium(mg/100g)	48.42
Zinc(mg/100g)	0.05
Sodium (mg/100 g)	225.06

*Protein calculated from a factor equals to 6.25

Analysis of fatty acid content of Chinese chives using riceberry flour with lettuce seaweed

The researchers analyzed the saturated fatty acid content and unsaturated fatty acids of Chinese chives products using riceberry flour enriched with seaweed lettuce (shown in Table 5). The fatty acid content of the products was examined by the type and amount of saturated fatty acids and unsaturated fatty acids, with nutrients derived from fat. However, the chemical compounds were different, having different health properties by saturated fat mostly from animal fats and animal products. Grovenor (2002) pointed out that this type of fat would accumulate in fat cells throughout the body and cause obesity). Unsaturated fats, or good fats, are plant-derived fats. This type of fat has less effect on obesity and cardiovascular disease than saturated fat. From the analysis of the amount and type of fatty acids under study, the developed chives recipe contained saturated fatty acids found in the range of 0.01-0.07 g per 100 g of sample weight, namely lauric, myristric, pamitric, stearic and lignoleic. Unsaturated fatty acids were also found, mainly oleic acid and linoleic acid, equal to 1.47 and 1.20 g per 100 g of sample weight. As reported by Insel et al. (2002), this type of fatty acid is necessary for the body (essential fatty acid), which is a fatty acid that the body cannot produce by itself, but must be obtained from the diet.

Table 5: Content of Saturated Fatty Acids and Unsaturated Fatty Acids of Chinese Chives Using Riceberry Flour and Seaweed Lettuce

Type of fatty acid		Saturated fatty acid (g/100 g of sample weight)
Lauric acid	(C12:0)	0.01
Myristic acid	(C14:0)	0.02
Palmitic acid	(C16:0)	0.77
Stearic acid	(C18:0)	0.09
Arachidic acid	(C20:0)	0.03
Behenic acid	(C22:0)	0.01
Lignoceric acid	(C24:0)	0.02
Type of fatty acid		**Unsaturated fatty acid (g/100 g of sample weight)**
Palmitoleic acid	(C16:1)	0.01
cis-9-Oleic acid	(C18:1n9c)	1.47
cis-11-Eicosenoic acid	(C20:1n11)	0.02
Linoleic acid	(C18:2n6c)	1.20
alpha- Linolenic acid	(C18:3n3)	0.12

4. Conclusions

The Chinese chives recipe development was carried out by adjusting the riceberry flour to rice flour formula at 4 levels: 0:100 (control sample), 10:90, 30:70 and 50:50 per-cent by weight. Sensory evaluation of preference by the experts indicated that the ratio of riceberry flour to rice flour supplemented in the amount of 30 percent by total weight received the highest overall likes rating. When combining the newly developed recipe of Chinese chives formula to supplement with lettuce seaweed in the amount of 0.1 percent per weight, the experts rated overall preference on texture and taste. In addition, the new chives recipe containing water activity at 0.97, pH at 5.51, and the number of microorganisms of 2.8 x 103 colonies per 1 gram sample, has met the community product standards. In terms of nutritional value, the recipe contains carbohydrates, dietary fiber, beta-carotene, magnesium and essential fatty acids both oleic acid and linoleic acid. The invention and development of a new chive formula in this study, therefore, has definitely added value for the product, as product enhancement in nutritional values for consumers and for the community’s economic growth. Yet, further studies should focus on the enrichment of community products using other useful raw materials locally available, including the storage of developed products in various conditions.

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