

NUTRITIONAL AND SENSORY QUALITY OF CHOUX PASTRY ENRICHED BY SALMON, SPINACH, AND SEAWEED

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Abstract

In pastry products, functional food can be developed by adding nutrients or additional components that are not generally found in these food sources. One of them is the choux pastry, for which the main ingredients are flour and fat. Substituting the choux pastry ingredients can increase its nutritional value. This study aimed to optimize choux pastry products' nutritional and sensory quality through composition and extrusion with salmon, spinach, and seaweed. Experiments were conducted by adding salmon, spinach, and seaweed ingredients and creating new product formulations, followed by sensory analysis after obtaining the standard formula preferred by the final panellists, which include calculating the nutritional content of the choux pastry product that has been formulated with additional ingredients. This research discovered the patisserie product formula, specifically the innovative nori, spinach, and salmon choux pastry. Based on the sensory test approach taken, it could be concluded that from the sensory profile, the colour parameter was $3.67 + 0.75$; while the texture parameter was $3.83 + 0.69$; and the taste was $4.17 + 0.69$, and overall results showed that it was very acceptable for the choux cake enriched with salmon, spinach and seaweed. Panellists favoured the appearance, aroma, and taste of choux pastry over the colours and textures. Besides, the nutritional value of the choux pastry formula with salmon, spinach, and seaweed contained the energy of 169.79 calories, 10.21 g protein, 4.68 g fat, and 16.32 g carbohydrates (per 100 grams of choux pastry).

Keywords: Choux Pastry, Food, Nutrition of choux pastry.

1. Introduction

The fundamental innovation trends are health, pleasure, and convenience, especially in patisserie products [1]. One of the patisserie products is a pastry that is constantly evolving [2]. Pastry refers to a mixture of flour, water (or water-based liquid), fat, and other ingredients containing a filling. The filling includes baking or frying, such as choux pastry, filled with a sweet and savoury filling [3].

Functional foods can be developed in pastry products by adding additional nutrients or components that are not generally found in that food source [4]. There are many recipes for choux pastry with the addition of functional ingredients. Also, there is various functional choux pastry such as dry choux pastry enriched by catfish [5], dry choux pastry enriched by cork fish [6], dry choux pastry with the addition of breadfruit flour [7], choux pastry with rice bran flour substitute [8] choux pastry supplement by soy flour and soy grits [9] and choux pastry semi-finished product enriched with an oyster mushroom powder [10]. However, previous studies reported that most of the development choux pastry recipes are applied to the dough.

Recently, a few studies have reported the choux pastry development on the dough and filling. Innovation in dough and filling pastry can increase the nutrition and functionality of choux pastry. Replacing simple sugar or carbohydrate with fibre and protein is a dietary strategy to improve health effects [11]. Salmon, spinach extract, and powdered seaweed (nori) can be used to reformulate pastry products. Salmon is added to enrich the filling of choux pastry. Furthermore, spinach extract and powdered are mixed with choux pastry dough.

Salmon is an excellent source of nutrients such as protein, lipids, vitamins, and minerals, significantly contributing to health [12]. The nutritional quality of cooked fillet salmon is not affected compared to raw salmon [13]. Baking as a preparation method does not alter salmon fillets' protein and fat qualities [14].

Spinach contains biologically active substances and can enrich different kinds of food production, including bakery products. The enrichment of bakery products with spinach can improve their quality, such as sensory characteristics, and increase organic acids and minerals content [15]. In addition, spinach-incorporated bakery products can be used as an alternative source to meet the fibre requirements [16]. Previous studies reported that spinach could be used to enrich different kinds of bakery products, such as doughnuts, biscuits, gluten-free cake, and chapati bread [15-19].

Bioactive seaweed substances are increasingly valuable in developing food products since they can give foods additional functions related to prevention and health promotion [20]. Seaweeds contain a significant number of soluble polysaccharides and as a source of dietary fibre [21]. Besides, seaweed composite flour improves the quality properties of dough and bread [21].

The current study aimed to develop a new choux pastry with potentially improved health benefits by incorporating salmon, spinach extract, and powdered seaweed (nori). Furthermore, a sensory evaluation is determined to evaluate the new products' acceptability by potential consumers. The fundamental innovation trends are health, pleasure, and convenience, especially in patisserie products [1]. One of the patisserie products is a pastry that is constantly evolving [2]. Pastry refers to a mixture of flour, water (or water-based liquid), fat, and other ingredients containing a filling. The filling includes baking or frying, such as choux pastry,

filled with a sweet and savoury filling [3]. Reformulating the choux pastry ingredients to satisfy hunger, provide essential nutrients for humans, prevent nutrition-related diseases, and improve consumers' physical and mental well-being.

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Salmon is regarded as an excellent source of nutrients such as protein, lipids, vitamins, and minerals that significantly contribute to health [12]. The nutritional quality of cooked fillet salmon is not affected compared to raw salmon [13]. Baking as a preparation method does not alter salmon fillets' protein and fat qualities [14].

Spinach contains biologically active substances and can be used to enrich different kinds of food production, including bakery products. The enrichment of bakery products with spinach can improve their quality, such as sensory characteristics, increase organic acids, and minerals content [15]. The spinach incorporated bakery products can be used as an alternative source to meet the fibre requirements [16]. Previous studies reported that spinach could be used to enrich different kinds of bakery products, such as doughnuts, biscuits, gluten-free cake, and chapati bread [15-19].

Bioactive seaweed substances are increasingly valuable in developing food products because they can give foods additional functions related to health promotion and disease prevention [20]. Seaweeds contain a significant number of soluble polysaccharides and as a source of dietary fibre [21]. Besides, seaweed composite flour improves the quality properties of dough and bread [21].

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2. Method

2.1. Materials

All ingredients for this study (such as salmon, spinach, seaweed, flour, milk, butter, and other vegetables) were purchased from Bandung's local retail network.

2.2. Choux pastry enriched by salmon, spinach, and seaweed samples preparation

The choux pastry enriched with salmon, spinach, and seaweed was made by preparing the ragout, dough and then stuffing the choux with ragout. The recipe used for the present research is shown in Table 1.

The first step to make ragout was by dicing carrots and potatoes, chopping garlic, onions, and celery, and chopping salmon after cleaning. The cube potatoes were fried until half cooked. Sautéed the onions until fragrant, then added pepper, coriander, and garlic until cooked. Next, put the chopped salmon in the stirred onion. Carrots and milk were added after the colour of chopped salmon changes to pale. Next, salt, sugar, and oyster sauce were added to the taste. Water was added if necessary. Finally, added the flour, stirred, and cooked until all of the flour had been mixed.

The step to make choux dough was to cut the spinach and blend it with an additional 100 ml of water. Spinach extract was obtained after filtering the mixture of spinach and water. The seaweed (nori) was cut then blended until it became powder. Next, 125 ml of spinach extract mixed with milk, butter, and salt, then boiled. After the dough was boiled, turned off the heat and added the flour. The dough was stirred with a wooden spoon quickly, so the dough did not stick to the pan. If necessary, heat the dough for 1-2 minutes to reduce the water content. After the dough was heated and the temperature was reduced, mixed the eggs one by one to create a shiny, thick, and smooth dough with a pipeable consistency. Put the soft dough in the piping bag with a nozzle. Pipe the dough into a rectangular shape (30 x 10 cm) onto the greased baking tray. Ragout, nori powder, and mayonnaise were added to the dough's top and covered with choux dough. Choux dough was baked at 185-200°C for 40 minutes to create a light, airy, puffy, and crisp pastry and sliced (10 x 4 cm) when it cooled.

Table 1. Recipe of choux pastry enriched by salmon, spinach, and seaweed.

Ingredient	Total Quantity
The dough of choux pastry	
High protein wheat flour	110 g
Milk	125 mL
Water	125 mL
Spinach	100 g
Salt	1 g
Butter	58 g
Egg	188 g (3 eggs)
Seaweed (nori)	25 g
Filling of choux pastry (ragout)	
Salmon	200 g
Carrot	100 g
Potato	100 g
Celery	20 g
Garlic	20 g
Onion	100 g
Pepper	2 g
Coriander	2 g
Salt	To taste
Sugar	To taste
Oyster sauce	15 mL
Wheat flour	30 g
Seaweed (nori)	12.5 g
Mayonnaise	100 g

2.3. Nutrition of choux pastry enriched by salmon, spinach, and seaweed

Nutrients are protein, carbohydrates, iron, calcium, various other vitamins, and minerals. The health benefits of spinach include being used for diet, maintaining eye health, fighting cancer, and much more. Apart from spinach for the choux pastry dough, we mixed nori, which is dried seaweed, given that seaweed has a complete essential content. Next, we used ragout for the choux pastry filling, which is different from the others, namely the salmon ragout. We chose salmon because the salmon's nutritional content is excellent, as well as its benefits. Finally, we combined this ragout with oriental spices added with oyster sauce. In addition, we made a surprise by adding mayonnaise so that there is a fresh taste when eaten.

The nutrients in the food are measured by using a calorie counting technique where the ingredients used are analysed by adding up the calories based on nutrients [23].

- (i) First, examine the recipe for the food product.
- (ii) See the list of ingredients in the choux pastry product.
- (iii) Record the protein, carbohydrate, and fat contents of the choux pastry product.
- (iv) Multiply each macronutrient by its calorie equivalent in choux pastry product
- (v) Count the total calorie for each macronutrient in the choux pastry product

The analysis of nutritional calculations on choux pastry products using the technique of adding calories to each ingredient used in choux pastry products is shown in Table 2.

Table 2. Product nutritional analysis.

No	Ingredients	Weight	Energy	Protein	Fat	Carbohydrate
1	Margarine	58 g	211.8	5.40	9.80	26.75
2	Milk	250 ml	375.0	15.00	10.00	5.50
3	Wheat flour	150 g	547.5	13.35	1.95	115.95
4	Spinach	100 g	16.0	0.90	0.40	2.90
5	Seaweed (Nori)	100 g	41.0	1.40	0.30	8.10
6	Salmon	200 g	284.0	39.68	12.68	0.00
7	Carrot	100 g	174.0	20.00	0.00	10.00
8	Potato	100 g	62.0	2.10	0.20	13.50
9	Leek	20 g	3.8	0.20	0.20	1.00
10	Onion	50 g	22.5	0.50	0.00	5.00
11	Garlic	20 g	19.2	0.80	0.00	8.40
12	Egg	200 g	308.0	24.80	21.60	1.40
Amount			2,064.8	124.13	57.13	198.50

2.4. Sensory analysis of choux pastry enriched by salmon, spinach, and seaweed

Table 3 shown the sensory analysis consists of a hedonic test and a quality hedonic test. Six untrained panellists evaluated the degree of preference (hedonic) of choux pastry with a 5-point hedonic scale (1= extremely dislike and 5 = extremely like). They involved the following parameters: appearance, colour, texture, taste, aroma, and overall acceptance. All untrained panellists were food entrepreneurs. The sensory profile of choux pastry was measured with the same panellists using a 5-point quality hedonic scale. It involved the following parameters: colour (1 = not

very green and 5 = very green), texture (1 = not very soft and 5 = very soft), taste (1 = not very savoury and 5 = very savoury), aroma (1 = not very specific aroma of choux pastry and 5 = definite aroma of choux pastry, which means it is the most preferable aroma). Panellists tested the samples and were asked to chew before scoring.

Table 3. Hedonic test.

Score	Appearance	Skin colour	Skin texture	Taste	Aroma	Overall acceptance
5	Extremely like	Extremely like	Extremely like	Extremely like	Extremely like	Extremely like
4	Like	Like	Like	Like	Like	Like
3	Slightly like	Slightly like	Slightly like	Slightly like	Slightly like	Slightly like
2	Dislike	Dislike	Dislike	Dislike	Dislike	Dislike
1	Extremely dislike	Extremely dislike	Extremely dislike	Extremely dislike	Extremely dislike	Extremely dislike

3. Results and Discussion

3.1. Nutrition of choux pastry enriched by salmon, spinach, and seaweed

Choux pastry is identical to foods that contain high fat because it is dominated by using wheat flour and fat. Therefore, to change the choux pastry into healthy food, we mixed other food ingredients as a nutritional enhancer to the choux pastry. In contrast, the ingredients added were salmon, spinach, and seaweed. The results of trials that had been carried out with the addition of other foodstuffs can be seen in Table 4 of energy parameters (cal), carbohydrates (g), fat (g), and protein (g) in 1 choux pastry.

Salmon is a healthy food being rich in essential nutrients. A previous study estimated the nutrition of six different salmon types, such as protein 47.4-89.8 (g/100 g dry weight); fat 3.8-51.3 (g/100 g dry weight); and total amino acids 43.3-84.5 (g/100 g dry weight) [12]. Although significant changes were investigated in the proximate composition, the nutritional quality of cooked salmon fillets was not affected compared to the control. The protein content of oven-baked salmon increase (22.09 g/100 g wet basis) compared to the raw salmon (18.66 g/100 g wet basis), while the fat content decreased of oven-baked salmon (8.19 g/100g wet basis) compared to the raw salmon (11.98 g/100 g wet basis) [13].

Table 4. Nutrient pf Choux pastry nori. Spinach and salmon per 1 piece (38 gram).

	Parameters			
	Energy (cal)	Carbohydrates (g)	Fat (g)	Protein (g)
per 1 piece (38 grams)	64.52	6.20	1.78	3.88
per 100 grams	169.79	16.32	4.68	10.21

Edible seaweeds are also rich in bioactive compounds such as soluble dietary fibres, protein-like (glycine alanine, arginine, and glutamic acid), vitamins, minerals, and trace elements [24]. Thus, for example, the edible leafy parts of two

spinach species contained more significant crude fibre, crude protein, ascorbic acid, Ca, K, Fe, and β -carotene than the spinach leaf [25]. Likewise, the elaboration of bakery products is rich in fibres and minerals and presents a considerable energetic value [26].

3.2. Sensory properties of choux pastry enriched by salmon, spinach, and seaweed

The level of preference and sensory profile of choux pastry can be seen in Table 5. Overall scores indicated highly acceptable choux pastry enriched by salmon, spinach, and seaweed. Panellists showed higher acceptance of the choux pastry's appearance, taste, and flavour of colour or texture. Based on the hedonic quality test (Table 6), choux pastry has a slightly green colour, a relatively soft texture, savoury taste, and a specific flavour of choux pastry.

Table 5. Sensory evaluation (hedonic) of choux pastry enriched by salmon, spinach, and seaweed.

Parameters	colour	texture	taste	flavour	overall acceptance	
Mean \pm SD ($n = 6$)	4.17 \pm 0.69	3.67 \pm 0.94	3.83 \pm 1.07	4.17 \pm 0.69	4.00 \pm 0.58	4.00 \pm 0.82

Table 6. Sensory profile of choux pastry enriched by salmon, spinach, and seaweed.

Parameters	colour	texture	taste	flavour
Mean \pm SD ($n = 6$)	3.67 \pm 0.75	3.83 \pm 0.69	4.17 \pm 0.69	4.17 \pm 0.69

Spinach and seaweed contribute to the green colour of choux pastry. Chlorophyll is the green pigment in spinach [27]. Temperature dependence is considered to degrade green colour, total chlorophyll, and ascorbic acid in spinach leaves during the baking process [28]. Seaweed carotenoid and fucoxanthin are giving them a brown or olive-green colour [20]. As functional ingredients, fucoxanthin has been studied clinically for its antioxidant properties, which inhibit free radical damage in cells, reducing the risk of many chronic diseases [29]. Carotenoid-rich extract from spinach presented a high antioxidant and an essential anti-inflammatory activity [30]. Enrichment of bakery products with spinach can save or improve their sensory characteristics, increase organic acids and minerals content [15].

Seaweeds have the potential to serve as a source of dietary fibre and soluble polysaccharides, which can increase water absorption, decrease stickiness, and increase dough firmness values [21]. Hydrocolloids from seaweeds, marine-based hydrocolloids, were also able to reduce the loss of moisture content, dehydration rate of crumbs and also showed an anti-staling effect retarding the crumb hardening during bread storage [31]. Interactions between the spinach fibre structure and the wheat proteins cause partial disruption of gluten, increasing the tenacity of the dough [17]. The dietary fibres in seaweeds can help prevent constipation, detoxify the digestive system, and avoid colon cancer [20]. The preference scores for texture

attributes in doughnuts with 10% spinach flour substitution are higher than doughnuts without spinach flour substitution [18].

Umami, the fifth basic taste, is used to describe the sensation of deliciousness [32]. Umami is based on hydrophilic monosodium L-glutamate (L-Glu) and, to a smaller extent, on L- aspartate (L-Asp), which can be found in free form in seaweeds [33]. Food producers and chefs can control umami sensation in food items using some of the most popular species of edible brown seaweeds [34].

The components that produce the umami flavour are also found in fish. Glutamic acid, methionine, glycine, aspartic acid, and lysine are of high taste activity values. They have substantial taste impacts on the mountain trout meat flavour [35]. Thus, cooking can enhance the flavour of high-quality fish. The quantity of the flavour components in processed fish and fishery products is much higher than that of raw fish. For example, baked salmon possessed a double number of components as raw salmon. Among the 26 ingredients identified in processed fish and fishery products majority are aliphatic hydrocarbons (alkane, alkene, cyclic hydrocarbons); some are carbonyl compounds (aldehydes, ketone); some are alcohols, organic acid, and two are aromatic compounds according to their molecular structure [36]. Choux pastry products enriched with other additives improve the product's quality and nutrition while also making it more visually appealing in terms of colour and texture [37]. This is in line with previous studies [38-41].

4. Conclusion

The addition of nutrients to functional food products is an alternative to increasing the nutritional content of food products. Optimizing choux pastry products' nutritional and sensory quality is carried out by adding other food ingredients, including salmon, spinach, and seaweed. Sensory quality can be seen from the texture, taste (taste odour, and visual aspects). The sensory properties of choux pastry are influenced by the content of ingredients that have a high-fat value. Therefore, the researchers conducted experiments by adding other food ingredients to have a quality product with good nutritional value. The investigation was conducted in several stages, starting from the preparation stage, recipe testing, to organoleptic and hedonic tests to produce a standard choux pastry product panellists liked and had a balanced nutritional content.

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