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Production and Quality of Sweet Fish Sauce (Nam Pla Wan) Whipping Cream

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ABSTRACT

Sweet fish sauce is a sweet dipping sauce usually served with sour fruit such as green mango and pineapple. The production of whipping cream products with sweet fish sauce was studied according to the needs of the Phuket Kaew entrepreneur to develop a new product that can be sold in the market. The optimal amount of sweet fish sauce for producing whipping cream was 15% (w/w of total ingredient weight). The foam capacity and foam stability of the sweet fish sauce whipping cream were gradually increased with sweet fish sauce concentration from 5% to 15% then declined when reached 20% ($p \leq 0.05$). On the other hand, the overrun value was not significantly different from the control ($p > 0.05$) but decreased when adding sweet fish sauce up to 20%. The addition of 15% sweet fish sauce received the highest liking scores and showed higher values in the textural characteristics including hardness, adhesiveness, cohesiveness, and chewiness than the control. The chemical compositions of the sweet fish sauce whipping cream resulted in significantly more ash, carbohydrate, and energy than the control ($p \leq 0.05$). In terms of shelf life, the sweet fish sauce whipping cream can be kept in the refrigerator for at least 15 days.

1. INTRODUCTION

Sweet fish sauce or “Nam Pla Wan” is a famous dipping sauce in Thailand that is sweet, sticky, slightly salty, and a hint spicy. The main ingredients are palm sugar, shrimp paste, fish sauce, shallots, dried shrimp, and chili. It is usually served with a green mango or sour fruits. It perfectly combines green mango and sweet fish sauce [1].

Whipping cream is cream that can be whipped from a liquid form into little peaks of creamy goodness [2]. Whipped cream, a popular dairy product, is cream already whipped and widely used for topping desserts, ice cream, cake, and some beverages [3,4]. Whipping cream is an emulsion-based structure that contains water, sugars, fat, protein, stabilizers, and emulsifiers and is stable during frozen storage [4,5]. A source of fat preparation for whipping cream is dairy milk. The two-phase oil-in-water emulsion is transformed into a three-phase system when the cream is whipped. The gathered air bubbles are trapped in a network of fat globules, including some proteins that will be denatured [6]. Whipped cream is an air-in-water foam that is a film containing fat droplets surrounding air cells and is stable by a protein film. There is some clumping of the fat globules in the cell walls of the foam, and the fat is partially solidified, preventing the collapse of the cell walls [7].

Desirable properties of whipped cream are a short whipping time, a high overrun, sufficient stiffness in the whipped cream to allow shaping, and lack of syneresis. Overrun is the percentage increase in volume when cream is whipped. The desirable overrun is greater than 80% [8].

The Phuket Kaew entrepreneur producing sweet fish sauce, beverages, and ice cream from sour mango wanted to use whipped cream with sweet fish sauce flavor as a topping. Therefore, this research aims to develop sweet fish sauce whipping cream including studying quality and shelf life as part of providing academic services to entrepreneurs in Phuket, Thailand.

2. MATERIAL AND METHODS

2.1 Material and chemicals

The sweet fish sauce obtained from the Phuket-Kaew entrepreneur was blended with a blender and filtered to separate the liquid parts for the production of sweet fish sauce whipping cream (SFW). All chemicals used in the investigation were analytical grade.

2.2 Preparation of sweet fish Sauce whipping cream

The ingredients used for making SFW based on the recipe [9] are shown in Table 1. Sweet fish sauce was added to whipping cream making in the following percentages: 0%, 5%, 10%, 15%, and 20% (w/w of total ingredient weight). The whipping cream process was started by mixing the sterilized milk with bloomed gelatin, then sugar was added and mixed evenly. It is pasteurized at 72 °C for 15 seconds, packed in aluminum foil bags then cooled at 4 °C, and stored in the refrigerator (10 °C) until use.

Table 1. Formulation of SFW with five different percentages of sweet fish sauce.

Ingredients	Quantities (g)				
	Control 0%	5%	10%	15%	20%
Milk	200	200	200	200	200
Gelatin	5	5	5	5	5
Sugar	2.80	2.80	2.80	2.80	2.80
Water	50	50	50	50	50
Sweet fish sauce	0	12.89	25.78	38.67	51.56

2.3 Determination of foaming properties

In the study of the foaming properties of the SFW, 100 ml of each sample was poured into a 1,000 ml beaker and whipped with a hand-blender at the highest level speed for 5 minutes. The foaming capacity (FC) and foaming stability (FS) were measured by observing the volume of the whipped creams in the beakers for 60 minutes [10,11] and calculated with Eq(1), Eq(2) and Eq(3) [11].

$$\% \text{ Foam capacities} = \frac{V_2 - V_1}{V_1} \times 100 \quad (1)$$

$$\% \text{ Foam stabilities} = \frac{V_{60}}{V_1} \times 100 \quad (2)$$

$$\% \text{ Overrun} = \frac{(\text{MUW} - \text{MW})}{\text{MW}} \times 100 \quad (3)$$

while, V1: Volume of foam before homogenization (mL); V2: Volume of foam after homogenization (mL); V60: Volume of foam after 60 minutes (mL); MUW: mass of unwhipped cream with a certain volume; MW: mass of whipped cream with a certain volume.

2.4 Sensory evaluation

Thirty panelists evaluated the sensory properties (appearance, foam stability, flavor, texture, and overall liking) according to a 9-point hedonic scale.

2.5 Textural characteristics analysis

The textural characteristics of SFW were investigated by filling SFW into the cylindrical mold and adjusting the height of SFW foam to have an equal height of mold [12]. The texture profile analysis was measured. Foam structure properties were performed by hardness index. In addition, the hardness (g), adhesiveness (mJ), cohesiveness, and chewiness (mJ) were determined.

2.6 Chemical analysis

Proximate composition i.e. moisture, protein, fat, ash, carbohydrate, and energy was determined using the standard method of AOAC [13].

2.7 Determination of microbial quality of SFW

The samples of SFW were placed in aluminum foil bags, and stored in the refrigerator (10 °C). The microbiological tests were evaluated every 3 days for 15 days to determine the total plate count (TPC) [13].

2.8 Statistical analysis

The experiments were performed in triplicates and all results were expressed as mean \pm standard deviation. The study's data were subjected to an analysis of variance (ANOVA) using SPSS. Significant differences among mean values were determined by Duncan's multiple range tests (DMRT), while pairwise comparison using the Least significant difference (LSD) with a 95% confidence interval that was significantly different ($p \leq 0.05$).

3. RESULTS AND DISCUSSION

3.1 Foaming properties

The various amounts of sweet fish sauce in SFW showed the effect on their FC, FS, and overrun in Table 2. The results showed that the FC of SFW at 5%, 10%, 15%, and 20% (w/w of total ingredient weight) were lower than the control (0%). The FS at 10% and 15% were higher than control. As the sugar, the main ingredient in sweet fish sauce increased, the soluble solids content, interface protein concentration, and fat coalescence increased so a more effective structure of whipped cream was formed to stabilize the aerated system, thereby leading to higher firmness [14]. The overrun values of 5%, 10%, and 15% showed no significant difference from the control ($p > 0.05$) except at 20%. It was observed that at 20% the values of FC, FS, and overrun were the lowest because of the increase of stickiness and thus inhibited the formation of air bubbles in the structure of the whipped cream in the whipping process to create air bubbles [15].

Table 2. Effect of sweet fish sauce amount on foam properties of SFW.

Sweet fish sauce (%)	FC (%)	FS (%)	Overrun (%)
0	490.22 ± 0.11 ^a	96.64 ± 1.74 ^b	83.05 ± 0.40 ^a
5	476.89 ± 0.62 ^b	96.96 ± 1.33 ^b	82.97 ± 0.43 ^a
10	483.89 ± 0.01 ^{ab}	98.26 ± 1.99 ^a	82.86 ± 0.31 ^a
15	488.44 ± 0.34 ^{ab}	98.77 ± 1.47 ^a	83.10 ± 0.28 ^a
20	467.89 ± 0.20 ^b	95.15 ± 1.55 ^b	81.64 ± 0.37 ^b

*FC, foaming capacity; FS, foaming stability; Data are expressed as means ± SD value. Different letters within the same column are significantly different at $p \leq 0.05$.

3.2 Sensory evaluation

The appearance of SFW is shown in Figure 1, where it can be observed that the color of the whipped cream becomes darker as the percentage of sweet fish sauce increases. The sensory evaluation results of SFW are shown in Table 3. SFW with 5% sweet fish sauce added received a likeability score that was no different from the control ($p > 0.05$). While, increasing sweet fish sauce up to 15% showed the highest likability scores in foam stability, flavor, and overall liking ($p \leq 0.05$), but decreased at 20% because of the too-strong flavor of sweet fish sauce and poor texture of SFW.

**Figure 5.** SFW was added with different percentages of sweet fish sauce.**Table 3.** Sensory evaluation of SFW.

Sweet fish sauce (%)	Sensory attribute				
	Appearance	Foam stability	Flavor	Texture	Overall liking
0	7.12 ± 1.17 ^b	7.01 ± 1.19 ^b	6.71 ± 1.14 ^b	6.93 ± 1.11 ^{ns}	7.11 ± 1.03 ^b
5	7.30 ± 1.19 ^b	7.12 ± 1.01 ^b	6.67 ± 1.13 ^b	7.10 ± 1.14	6.92 ± 0.44 ^b
10	7.71 ± 1.07 ^a	7.80 ± 0.98 ^a	7.74 ± 0.88 ^a	7.13 ± 0.20	7.94 ± 0.98 ^a
15	7.71 ± 1.19 ^a	7.92 ± 1.08 ^a	7.89 ± 1.03 ^a	7.10 ± 0.11	7.98 ± 1.05 ^a
20	7.22 ± 1.05 ^b	5.91 ± 1.20 ^c	6.08 ± 1.20 ^c	6.99 ± 1.05	7.28 ± 0.14 ^b

*Data are expressed as means ± SD values obtained from 30 panelists. Different letters within the same column are significantly different at $p \leq 0.05$. ns indicates not significantly different at $p > 0.05$.

3.3 Textural characteristics analysis

The result of the textural characteristics analysis of SFW is shown in Table 4. The SFW with 15% sweet fish sauce showed more hardness, adhesiveness, cohesiveness, and chewiness than the control ($p \leq 0.05$). Because the sugar in the sweet fish sauce affects the foam properties such as the whipping index, the index of foam durability, and specific density gradually increases with sugar concentration [16].

Table 4. Texture profile analysis (TPA) of SFW compared with control.

TPA	Sweet fish sauce (%)	
	0%	15%
Hardness (g)	25.00 ± 1.00 ^b	29.83 ± 1.04 ^a
Adhesiveness (mJ)	0.64 ± 0.10 ^b	0.82 ± 0.02 ^a
Cohesiveness	1.17 ± 0.10 ^b	1.57 ± 0.14 ^a
Chewiness (mJ)	0.46 ± 0.09 ^b	0.88 ± 0.10 ^a

*Data are expressed as means ± SD values obtained from 3 replications. Different letters within the same row are significantly different at $p \leq 0.05$.

3.4 Chemical analysis

The chemical composition of SFW is shown in Table 5. The addition of sweet fish sauce reduced the content of moisture and protein but ash, carbohydrate, and energy increased significantly ($p \leq 0.05$) compared to the control. In contrast, the fat content was not significantly different ($p > 0.05$). Normally dairy cream contains 16 to 40 % fat content [17]. SFW has approximately 24% more energy than the control because the main component of sweet fish sauce is sugar.

Table 5. The chemical composition of SFW compared with control.

Chemical composition (%)	Sweet fish sauce (%)	
	0%	15%
Moisture	70.32 ± 0.18 ^a	58.69 ± 0.09 ^b
Protein	4.15 ± 0.34 ^a	3.55 ± 0.03 ^b
Fat	16.18 ± 0.05 ^{ns}	16.92 ± 0.11
Ash	0.52 ± 0.04 ^b	0.84 ± 0.07 ^a
Carbohydrate	8.83 ± 0.10 ^b	20.01 ± 0.14 ^a
Energy (Kcal)	197.54 ± 0.09 ^b	246.52 ± 0.10 ^a

*Data are expressed as means ± SD values obtained from 3 replications. Different letters within the same row are significantly different at $p \leq 0.05$. ns indicates not significantly different at $p > 0.05$.

3.5 Microbial quality of SFW

Table 6 shows the effect of the storage period on total bacterial count. There showed no evidence of microbes (colony/gram) in both control and SFW during storage indicates that the SFW could be kept for more than 15 days.

Table 6. The effect of the storage period on the total bacterial count of SFW.

Storage time (days)	Total bacterial count (cfu/g)	
	0%	15%
0	Not found	Not found
3	Not found	Not found
6	Not found	Not found
9	Not found	Not found
12	Not found	Not found
15	Not found	Not found

4. CONCLUSIONS

The optimum amount of sweet fish sauce used in SFW production was 15%, which gave the best FC, FS, and overrun values similar to the control. It also received the highest liking score from 30 panelists. The shelf-life of SFW was satisfactory in a refrigerator for more than 15 days. Therefore, it is suitable for Phuket Kaew entrepreneur to produce for commercial.

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