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# Formulation and Quality Evaluation of Instant Sweet-Shrimp Paste (Kapi Wan) Powder

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**Abstract**

The sweet-shrimp paste sauce (Kapi Wan) is a traditional Thai fruit dip prevalent in Southeast Asia. In this study, an instant sweet-shrimp paste powder was developed as a new product for convenience, portability and ease to use. The shrimp paste powder prepared by sun drying in a combination of hot air oven exhibited a low moisture content (8.53%) and $a_w$ value (0.47) which preserved the character of natural color and flavor of the raw material. For an instant product preparation, the proportion of three ingredients, e.g., shrimp-paste powder (40-60%), palm sugar powder (10-30%) and cayenne pepper (10-30%), mixed with 30% ground dried shrimp (fixed ingredient) were studied. Choosing the most suitable formula from a total of 7 treatments based on the sensory attributes in terms of appearance, color, flavor, taste and overall liking by using the overlapping area of the contour plot of all factors. The best formula was treatment No. 1 (46.15% shrimp paste powder, 23.08% palm sugar powder, 7.69% cayenne pepper and 23.07% ground dried shrimp) which had the highest score in taste and overall liking. The product contained 12.01% of moisture content and the $a_w$ value was 0.52. Total protein, fat, carbohydrate and ash contents were 33.52, 3.81, 31.49 and 19.01%, respectively. The second best treatment was Treatment No. 5 (41.03% shrimp paste powder, 17.95% palm sugar powder, 17.95% cayenne pepper and 23.07% ground dried shrimp), which showed similar physiochemical properties, except a significantly ($p \leq 0.05$) higher in fat (4.87%) and lower in ash (18.37%) content. Both treatments had the potential to develop an instant sweet-shrimp paste powder; as treatment No. 1 being a non-spicy and spicy formula as treatment No. 5. The sensory score ranged from like slightly to like moderately.

## Introduction

The fermented shrimp paste is the most widely used condiment and seasoning ingredient in Southeast Asia. In Thailand it is commonly known as Kapi, while in other countries its prominent names include; Bagoong (Philippines), Prahok (Cambodia), Belacan (Malaysia), Ngapi (Myanmar), Mam ruoc (Vietnam) and Terasi

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(Indonesia). The making of fermented shrimp paste depends on the raw materials available in each nation (Hajeb & Jinap, 2012; Daroonpunt et al., 2016). Kapi is a thick, paste-like, purple-pink color, with a unique aroma, which is made by mixing the planktonic shrimp (Acetes sp. and Mesopodopsis sp.) with salt and then undergoes fermentation for several months (Daroonpunt et al., 2016; Kleechaya et al., 2021). In Thailand, shrimp paste is produced in many coastal areas as well as the estuary of the Gulf of Thailand in the provinces of Samut Songkhram, Samut Prakan, Samut Sakhon and Phetchaburi (Kleechaya et al., 2021).

The main characteristic of shrimp paste is providing a salty and umami taste, resulting from enzymatic protein hydrolysis to produce high amino acid content and nucleotides (Hajeb & Jinap, 2012). Therefore, shrimp paste is often used as an ingredient in various dishes to enhance the taste and flavor. The most famous and widely popular are shrimp paste chili sauce (Nam Prick Kapi), spicy shrimp paste soup (Kaeng Lieng), shrimp paste fried rice (Khao Kluk Kapi) and sweet-shrimp paste dip (Kapi Wan). At present, shrimp paste products are developed to match the consumer's lifestyles by generation, for example, low sodium shrimp paste (Cai et al., 2017; Jittrepotch et al., 2020; Rujirapong et al., 2022), shrimp paste powder (Sari et al., 2018), shrimp paste crackers (Retnaningsih et al., 2021) and instant shrimp paste chili sauce powder (Intarapan et al., 2021). However, the products are not versatile and little research has been reported.

The sweet-shrimp paste dip named Kapi wan refers to the ready-to-eat product that contains as its main ingredients sugar and shrimp paste and is prepared by simmering until sticky, then adding ingredients such as dried shrimp, dried fish, chopped onion and chili (TCPS 1496/2561). It's a Thai traditional fruit dipping sauce, however a similar recipe can be found in Philipines (Ginisang Bagoong), Vietnam (Mắm Ruốc Tôm Chấm Xoài), Malaysia, Indonesia and Singapore (Rojak) (Liagre, 2020; Pham, 2021; Manalo, 2022). Generally, this product has the characteristic of sticky liquid and a strong aroma which takes a long time to prepare. Kapi wan is usually sold in plastic packaging or glass jars. The glass jars are very heavy and inconvenient to move and transport. Moreover, a long storage time in unsuitable conditions will cause the product to deteriorate. According to the limitations, developing the sweet-shrimp paste dip into an instant product is a challenge. The product form of an instant dried powder offers the advantage of smell reduction, prolonged shelf-life, lightweight and easy to carry. Interestingly, it is possible to expand the export market as well, especially for the Asian population of overseas as well as offering convenience to customer who wants to save time in the kitchen.

Thus, this research studied the proportion ratio of ingredients (shrimp paste powder, palm sugar powder and cayenne pepper) in order to develop an instant sweet-shrimp paste powder using a mixture design experiment. The qualities of the finished product in terms of physical, chemical and sensory characteristics were investigated.

## Materials and methods

### 1. Raw material and ingredients

The completely ripened shrimp paste (Ruea Thai, Kra Sah Khao Community Enterprise, Samut Sakorn, Thailand), palm sugar powder (Dao Rai, Community Enterprise of Ban Khlong Chaun Housewives Farmers Group, Songkla, Thailand), cayenne pepper (Rai Thip, Siam Makro Public Company Limited, Thailand) and dried shrimp (Worarat market, Sathorn, Bangkok, Thailand) were used in the experiment. Before experimenting, the dried shrimp was grounded into a tiny flake using a blender.

### 2. Shrimp-paste powder preparation

Shrimp paste was molded into a ball with a diameter of 1.5 cm. and placed in an aluminum tray followed by sun-dried until the moisture content reduced to less than 40% (7 hr). This process was conducted on a sunny day with a climate around 32-35°C from January to March 2020. To evaluate the moisture content, three pieces of a ball were picked randomly for examination using the infrared moisture balance (FD 720; Kett, Japan) every 1-2 hr. The of drying was performed by grounding the shrimp paste ball into a small piece and placed in the hot air oven at 70°C for 5 hr. After that, the sample was blended to obtain a fine powder (8.53% moisture content) using a blender (MX-AC400, Panasonic, Thailand). The preparation method was derived from the preliminary experiment, which found that the partially dried with the sun significantly preserved the shrimp-paste flavor and color better than when the whole process used a hot air oven.

### 3. Experimental Design

The mixture design was used to formulate the combination of three components, *e.g.,* shrimp paste powder (40-60%), palm sugar powder (10-30%) and cayenne pepper (10-30%). The fixed factor was 30% ground-dried shrimp. The studied points in the corresponding triangle area were determined using the Minitab V. 17 programs, including seven treatments as shown in Table 1. Table 2 presents the percentage of an ingredient in each treatment when mixed with ground-dried shrimp.

The optimal treatment was selected by the overlapping contour plot of 5 characteristics of a sensory attribute (appearance, color, flavor, taste and overall liking), described in sub-topic 7.

**Table 1** The weight of the ingredients of sweet-shrimp paste powder in different treatments

| Ingredient (g) | Treatment* | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Shrimp paste powder | 60.00 | 56.67 | 56.67 | 60.00 | 53.34 | 46.66 | 40.00 |
| Palm sugar powder | 30.00 | 26.67 | 16.67 | 10.00 | 23.33 | 26.67 | 30.00 |
| Cayenne pepper | 10.00 | 16.66 | 26.66 | 30.00 | 23.33 | 26.67 | 30.00 |

**Remark:** * All treatments were mixed with the 30 g of ground dried shrimp to obtain 130 g total weight

**Table 2** Percentage of the ingredients of sweet-shrimp paste powder in different treatments

| Ingredient (g) | Treatment* | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Shrimp paste powder | 46.15 | 43.59 | 43.59 | 46.15 | 41.03 | 35.89 | 30.77 |
| Palm sugar powder | 23.08 | 20.52 | 12.82 | 7.69 | 17.95 | 20.52 | 23.08 |
| Cayenne pepper | 7.69 | 12.82 | 20.51 | 23.08 | 17.95 | 20.52 | 23.08 |
| Ground dried shrimp | 23.08 | 23.08 | 23.08 | 23.08 | 23.08 | 23.08 | 23.08 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Remark:** * All treatments were mixed with the 30 g of ground dried shrimp to obtain 130 g total weight

## 4. Moisture content and water activity ($a_w$)

The moisture content of sweet-shrimp paste powder was analyzed according to the standard method of AOAC (2000) using a hot air oven at the condition of 105°C. The $a_w$ was measured using the water activity meter (Serie 3TE, Aqualab, Switzerland) and calibrated with distilled water to obtain the $a_w$ of 1.00±0.01 before the experiment.

## 5. Color

The color of sweet-shrimp paste powder was measured using a color meter (D/8-S, Miniscan XE Plus, USA) and reported in the Hunter Lab system (L*, a*, b*). The L* referred to lightness in which 0 = black and 100=white. The a* referred to redness (positive value) and greenness (negative value). The b* referred to yellowness (positive value) and blueness (negative value).

## 6. Protein, fat, carbohydrate and ash contents

Protein, fat, carbohydrate and ash contents were determined according to the standard method of AOAC (2000). Crude protein was analyzed using the Kjeldahl method based on the total nitrogen in the sample. The percentage of crude protein was reported by multiplying the determined total nitrogen by a nitrogen-to-protein conversion factor (6.25). Crude fat was analyzed by the Soxhlet method, using petroleum ether as the solvent extraction. For ash analysis, the defatted sample was incinerated in the furnace at 535°C overnight until obtaining a white color with stable weight. Total carbohydrate content was determined by calculating the percent remaining after all other components has been subtracted.

## 7. Sensory evaluation

Sensory attributes of seven formulas of sweet-shrimp paste powder in terms of appearance, color, flavor, taste and overall liking were evaluated by 30 untrained panelists. All samples were individually coded with a 3-digit number. To prepare samples, the panelist was asked to pour one part of warm water into two parts of a mixture of dry powder that was placed in a white ceramic cup, followed by stirring to give a continuous paste (around 30-45sec). The sample was served with a piece of green mango (*cv.* Khiew Sawoey). The panelists were suggested to score in five characteristics of the sensory attributes using the 9-point hedonic scale (1= dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5= neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9=like extremely). An appearance was defined as the size, shape of dried-mix powder and the consistency of rehydrated product. A visual color appearance and a flavor sensation perceived by the test organ are characteristic descriptions of color and flavor, respectively. For the characteristic of taste, a preference for sweet, sour, salt and umami perceived by the tongue was noted. The whole satisfaction of the products was scored in terms of overall liking. Furthermore, clearing the mouth with drinking water was requested for all panelists before testing the next sample.

## 8. Statistical analysis

The experiment was conducted using a mixture design including 7 treatment combinations. All analyses were performed in triplicate and reported as mean ± standard deviation. Comparison of the mean value by Duncan's multiple range test for seven treatments and Independent sample t test for two treatments, using SPSS program V.

27 (An IBM Company, Ontario, Canada) for analysis of variance at P ≤0.05. The contour and overlay graph were created using Minitab Program V.17 (Minitab, LLC., USA).

## Results and discussion

### 1. Physical properties of shrimp paste powder

The physical properties of shrimp pasted powder prepared by partial reduction of moisture content by the sun before drying in a hot air oven are shown in Table 3. The moisture content of the sample was lower than 10%, according to the criteria of the Thai Community Products Standard of shrimp paste powder (TCPS 675/2561). The percentage of moisture content was a direct correlation to the low $a_w$ value, shown in Table 3 as being 0.47. The criteria $a_w$ did not exceeded 0.85 (TCPS 675/2561). The visible color of shrimp paste powder was purple-brown as the natural color of raw material, correlating to the low L* value (close to black; 0), positive a* (redness) and b* (yellowness). The drying operations could retain the color, flavor and aroma of raw material better than the application of hot air throughout the process (data not shown).

**Table 3** Physical properties of shrimp paste powder

| Parameter | Value |
|---|---|
| Moisture content (%) | 8.53 ± 0.57 |
| Water activity ($a_w$) | 0.47 ± 0.01 |
| L* | 32.07±5.71 |
| a* | 5.54 ± 0.36 |
| b* | 9.64±1.36 |

**Remark:** The data presented by mean ± SD (n = 3)

To prepare shrimp paste powder, it is necessary to remove partial moisture content by sun-drying before the second step of dehydration in a hot air oven to preserve the flavor and color of the product. The total time for drying was 12 hr (7 h; 1st step and 5 h; 2nd step). The development of natural brown color in shrimp paste occurred through the enzymatic and non-enzymatic processes (Daroonpunt et al., 2016). Free amino acids and small peptides could undergo a Maillard reaction during fermentation, contributing to a non-enzymatic browning (Pongsetkul et al., 2019). For enzymatic browning, it is principally caused by the melanosis induced by the polyphenol oxidase (PPO)-catalyzed oxidation of tyrosine and its derivatives. The shrimp PPO is commonly known as tyrosinase, which is related to the biosynthesis of melanin (Shao et al., 2019). However, the prolonged hot air drying resulted in fading of dried-powder color (higher L* and b* value) observed in the preliminary experiment (data not shown), possibly due to the oxidation of free astaxanthin under the condition accordingly (Daroonpunt et al., 2016). This observation was in agreement with Sari et al. (2018), the low drying temperature (40°C, 6 days) of dried shrimp paste mixed with Angkak pigment could retain the chemical composition and antioxidant activity effectively when compared to a high temperature (50 and 60°C). The flavor volatile substance might be destroyed during the dehydration process, *e.g.,* Trimethylamine, 2,5- Dimethylpyrazine, 2,6-Dimethylpyrazine, 2,5-Dimethyl-3-Ethylpyrazine, 2-Ethyl-5-Methylpyrazine, 2-Methylbutyric Acid, 3-Methyl Butanal, 3-Methylbutanol and Dimethyl Trisulfide (Kleekayai et al., 2016).

Shrimp paste is a good source of polyunsaturated fatty acid (PUFA), such as docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA) and arachidonic acid (AA), which have many beneficial effects on human health (Pongsetkul et al., 2019). These PUFA has been reported to lowering plasma cholesterol (Zuliani et al., 2009), the prevalence of cardiovascular diseases and acute cardiac death (Ander et al., 2003). Noticeably, the development of flavor in shrimp paste occurred during periods of fermentation process undergo lipolysis by endogenous and microbial enzymes in raw material and further oxidation. Aldehyde and ketone are outstandingly oxidation products obtained from the oxidation processes (Pongsetkul et al., 2017; Pongsetkul et al., 2019). However, a higher rate of lipid oxidation might limit its shelf-life because oxidation products are generally further decomposed to off-flavor volatiles (Pongsetkul et al., 2022). According to the effect of heat, it might destroy the flavor and aroma compound, which is considered as a natural characteristic of shrimp paste. It is also experienced in the same way as an important fatty acid related to health promotion. The effect of heat or processing conditions has been reported in related products such as salts shrimp powder (AlFaris et al., 2022) and foam-mat dried shrimp powder (Azizpour et al., 2016). The preparation of salted shrimp by grilling (15 min), frying (7 min), or boiling (15 min), before subsequently drying at 50°C for 72 hr and further crushing into a powder, affected their nutritional and antioxidant profiles, especially grilling (AlFaris et al., 2022). The foam-mat dried shrimp powder exposed to the temperature of 90°C resulted in the development of a Maillard reaction when compared to 40, 60 and 75°C, indicated by increasing a* value and declining L* value (Azizpour et al., 2016).

A different technique to prepare shrimp paste powder was reported by Barcelon et al. (2023), in which shrimp paste was diluted with water (1:1 to 1:4) and further undergoes spray drying. The factors that affected yield, moisture content and $a_w$ value were temperature inlet (140-180°C) and feed flowrate (15-35 mL/min), while the low dilution ratio (1:1 and 1:2) affected better consumer acceptability in color, aroma and flavor.

**2. Selecting the optimal formula of sweet-shrimp paste powder**

The dried shrimp paste was used as the main ingredient of three components (shrimp paste powder, palm sugar powder and cayenne pepper) to produce an instant sweet shrimp paste powder. Three components of the mixture contour plot of qualities factor of appearance, color, flavor, taste and overall liking are shown in Fig. 1 (a-e). The results showed that an increase in palm sugar tends to raise sensory attributes of appearance, flavor, taste and overall liking (Fig. 1a, c, d and e). A large amount of cayenne pepper experienced a higher score of color (Fig. 1b). Nevertheless, the appearance and taste characteristics declined when the proportion of cayenne pepper increased (Fig. 1a and c). The sensory characteristics in terms of appearance, color, flavor, taste and overall liking of seven treatment combinations were in the range of 6.33-6.50, 6.07-6.43, 6.13-6.70, 5.77-6.53 and 6.07-6.53, respectively, however, there was no significant difference (p>0.05) between treatments (Table 4). Thus, the overlapping area of the contour plot was used to select the best formula given the appropriate concentration of each factor.

The overlapping graph of all sensory attributes of sweet-shrimp paste powder is shown in Fig. 2. The area of treatment No. 1 (60% shrimp paste powder, 30% palm sugar powder and 10% cayenne pepper) and 5 (53.34% shrimp paste powder, 23.33% palm

**Table 4** Sensory score of seven treatments of sweet-shrimp paste powder

| Sensory attributes | Treatment | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Appearance ns | 6.37±1.25 | 6.50±1.22 | 6.33±1.27 | 6.33±1.47 | 6.47±1.38 | 6.43±1.41 | 6.50±1.38 |
| Color ns | 6.07±1.36 | 6.17±1.23 | 6.40±1.35 | 6.40±1.50 | 6.43±1.22 | 6.40±1.40 | 6.40±1.35 |
| Flavor ns | 6.47±1.38 | 6.70±1.15 | 6.40±1.35 | 6.60±1.52 | 6.20±1.37 | 6.40±1.48 | 6.13±1.33 |
| Taste ns | 6.53±1.68 | 6.33±1.24 | 5.77±1.55 | 6.03±1.43 | 6.17±1.46 | 6.50±1.28 | 6.23±1.28 |
| Overall liking ns | 6.53±1.43 | 6.33±1.15 | 6.07±1.41 | .10±1.30 | 6.33±1.30 | 6.43±1.36 | 6.17±1.42 |

**Remark:** ns = no significant difference

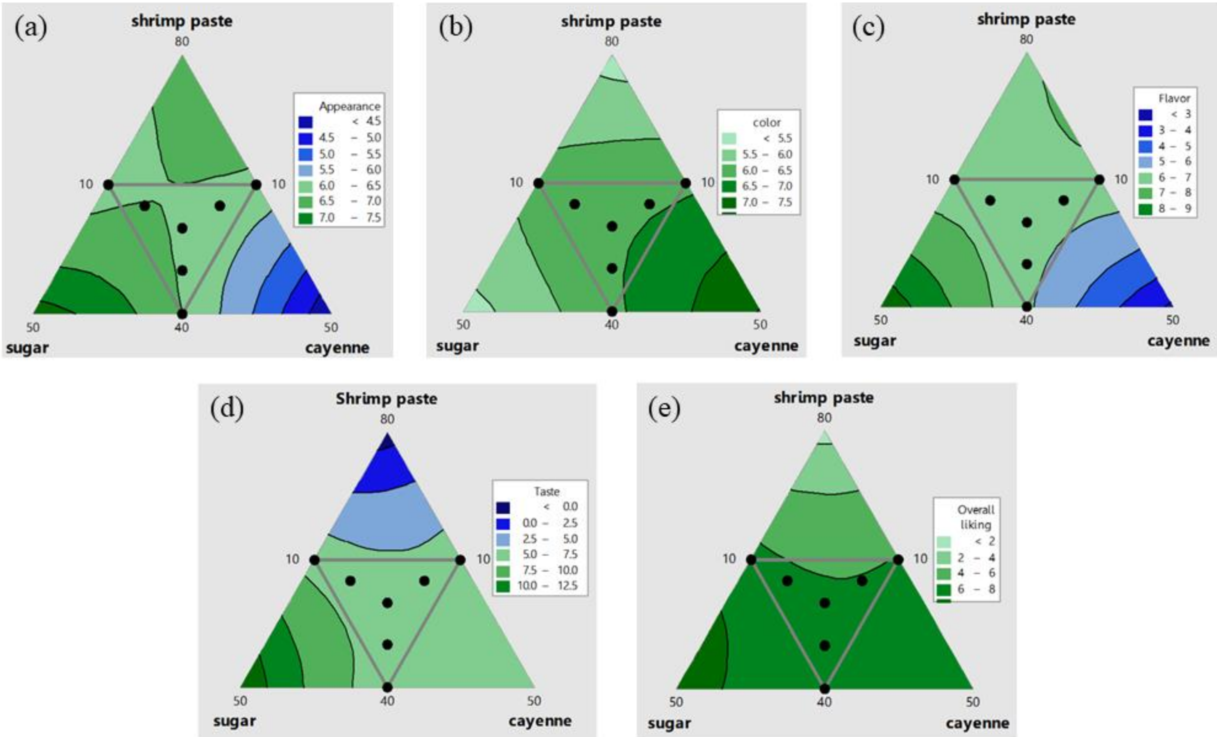


**Fig. 1** Mixture contour plot of three compositions for the sensory attributes: appearance (a), color (b), flavor (c), taste (d), and overall liking (e) of sweet-shrimp paste powder

sugar powder and 23.33% cayenne pepper) showed the most overlapping point for all considered factors, confirmed by the highest score of taste (6.53±1.68) and overall liking (6.53±1.43), even though it was not significantly different ($p$>0.05) from other treatments (Table 4). For treatment No. 5, the good appearance (6.47±1.38) and color (6.43±1.22) were noted, while the overall liking score was 6.33±1.30. All sensory attributes of both treatments ranged from like slightly to like moderately. The appearance of treatment No. 5 had a brighter red color than treatment No. 1 because of a high proportion of cayenne pepper (Figure 3), indicated by a high a* value (Table 5). Both treatments contained similar ingredient content, except for cayenne pepper (low and high levels), indicating the panelists separating into like and dislike spicy.

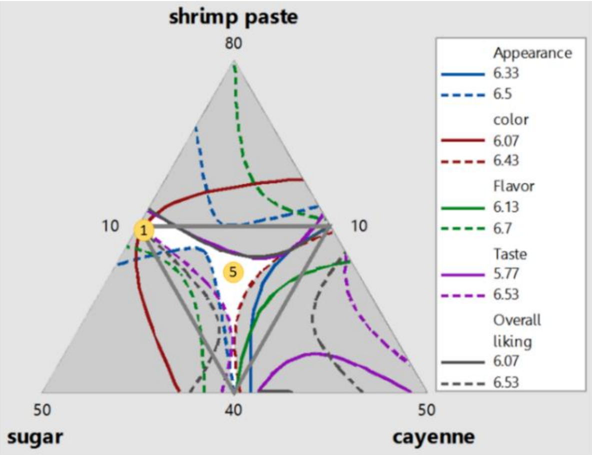


**Fig. 2** Overlapping graph of all sensory attributes, selected from the area with the appearance score between 6.33-6.5, color 6.07-6.43, flavor 6.13-6.70, taste 5.77-6.53 and overall liking 6.07-6.53. The area marked with No. 1 represented the formulation of 60% shrimp paste powder, 30% palm sugar powder and 10% cayenne pepper. The area marked with No. 5 represented the formulation of 53.34% shrimp paste powder, 23.33% palm sugar powder and 23.33% cayenne pepper


**Fig. 3** Appearance of all treatments of an instant sweet-shrimp paste powder

## 3. Physicochemical properties of sweet-shrimp paste powder

The sweet-shrimp paste powder in treatments 1 and 5 were selected for determining the physicochemical properties in terms of color (L*, a* and b*) and proximate components as shown in Table 5. The percentage of moisture content of the sample in treatment No. 5 (13.99%) was significantly higher (p≤0.05) than in treatment No. 1 (12.01%), which was in the same trend of $a_w$ value, shown in Table 5 as being 0.52 (treatment No. 1) and 0.53 (treatment No. 5). However, there was no significant difference (p>0.05) in $a_w$ value between treatments. Presently, there are no Thai standard for the sweet-shrimp paste powder or other related products, however, the moisture content of this product was higher than the standard of shrimp paste powder which did not exceed 10% (TCPS 675/2561). This might be due to it containing other ingredients, especially a palm sugar powder, identified as a hygroscopic material that acted to absorb moisture quickly under high relative humidity (Saputro et al., 2020). For a suggestion, the roasting could be applied to a final product to eliminate some moisture content of dried mix for prolonging the shelf-life.

The appearance of treatment No. 5 was visually red (Fig. 3) resulting in a higher a* value (11.59) compared to treatment No. 1, because of the high content of cayenne pepper. For chemical properties, the content of protein (32.73-33.96%) and carbohydrate (30.60-31.49%) in both treatments were similar, which had no statistically significant (p>0.05) difference between treatments. However, a large amount of protein content was observed in treatment No. 1, because it was rich in protein sources, including shrimp-paste powder (46.15%) and ground dried shrimp (23.07%), as shown in Table 2. The fat content of treatment No. 5 (4.73%) was significantly higher (p≤0.05) than treatment No. 1 (3.86%), which might be due to it containing a large amount of cayenne pepper (17.95%). The nutritional labeling of raw material of cayenne pepper showed 17g/100g total fat content (26% of daily value). The standard of total fat content in cayenne pepper reported by the U.S. Department of Agriculture is 17.3g/100g (USDA, 2019), considered to be similar to the raw material used in this experiment. The ash content in food refers to the mineral or inorganic remaining after removing moisture, volatiles and organic matter by complete oxidation under a very high temperature. Treatment No. 1 consisted of a higher ratio of shrimp paste powder (46.15%) which was abundant in $CaCO_3$ in whole shrimp containing shell supplemented with NaCl as a preservative (Pongsetkul et al., 2015). Moreover, dried shrimp is a source of calcium, potassium, copper, iron, phosphorus, magnesium, zinc and sodium (AlFaris et al., 2022).

**Table 5** Physicochemical properties of sweet-shrimp paste powder

| Parameter | Treatment | |
|---|---|---|
| | 1 | 5 |
| Moisture content (%) | 12.01 ± 0.18$^{b}$ | 13.99 ± 1.33$^{a}$ |
| Water activity ($a_w$) | 0.52 ± 0.00$^{ns}$ | 0.53 ± 0.01$^{ns}$ |
| L* | 15.81 ± 1.46$^{ns}$ | 16.96 ± 2.68$^{ns}$ |
| a* | 9.79 ± 0.47$^{ns}$ | 11.59 ± 1.06$^{ns}$ |
| b* | 16.32 ± 0.66$^{ns}$ | 18.07 ± 2.47$^{ns}$ |
| Protein (%) | 33.52 ± 0.38$^{ns}$ | 32.31 ± 0.99$^{ns}$ |
| Fat (%) | 3.86 ± 0.02$^{b}$ | 4.73 ± 0.09$^{a}$ |
| Carbohydrate (%) | 31.49 ± 0.41$^{ns}$ | 30.60 ± 0.66$^{ns}$ |
| Ash (%) | 19.01 ± 0.57$^{a}$ | 18.37 ± 0.10$^{b}$ |

**Remark:** The data is presented by mean ± SD (n = 3)
The value marked by different letters represented the significant difference ($p \leq 0.05$). ns = not significant difference

Sweet-shrimp paste powder is a new product as an instant dipping sauce for fruits that provides sweet, savory and umami taste. The enlargement of the umami taste occurred during the fermentation and formed a degraded product, amino acid, nucleotides and salt (Hajeb & Jinap, 2012). There has been a report that glutamic and aspartic content in Kapi was 3.96-4.3 and 2.24-2.55 mg/100g, which were the main features of taste attributes (Kleekayai et al., 2016). This is the first time reporting on the development of instant sweet-shrimp paste powder. However, a similar product of instant Nam Prick Kapi (Thai shrimp paste chili sauce) powder has been noted by Intarapan et al. (2021), prepared by tray drying at 70°C for 6 h. The instant Nam Prick Kapi powder had a 9.10% moisture content and the $a_w$ value was 0.37. In comparison to this study, the $a_w$ value of sweet-shrimp paste powder was around 0.52, characterized as a dried food ($a_w$ <0.6), which inhibited the microorganism growth (Fellows, 2009).

## Conclusion

The best treatment for producing an instant sweet-shrimp paste powder was treatment No. 1, containing the ingredients of 46.15% shrimp paste powder, 23.08% palm sugar powder, 7.69% cayenne pepper and 23.07% ground dried shrimp. All sensory attributes were classified as good (ranging from like slightly to like moderately), especially in terms of taste and overall liking, which received better scores than other characteristics. The finished product had a 12.01% moisture content and the $a_w$ value was 0.52. The percentage of crude protein, fat, carbohydrate and ash content were 33.52, 3.86, 31.48 and 19.01%, respectively. Treatment No. 5 was recommended alternatively for producing the spicy formula as it contains a large amount of cayenne pepper. The results of this study showed the processing was suitable for manufacturing an instant sweet-shrimp paste powder for small and medium enterprises (SMEs). The consumption could be directly dipped or filled with warm water as a semi-instant product. Further study should be conducted to consider microorganism safety and the shelf-life of the product. For commercial applications, unique features such as a rehydration ratio or viscosity, including a consumer test with a larger population (at least 50 participants) of two selected formulas should be investigated. The product should be kept in a package preventing moisture absorption during storage periods to preserve the product quality.

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