Sensory Characterization of Instant Tom Yum Soup

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Abstract
Instant tom yum soups are widely available in the market in various forms, powder, paste, and liquid. Despite the similarity in the use of key ingredients, each product is unique in flavor. The aim of this study was to characterize the sensory profile of instant tom yum soup. Descriptive analysis was performed to examine the sensory profiles of 12 instant tom yum soups. Sensory descriptors were generated; appearance (color, amount of oil, cloudiness), aroma (modified lime, pungent, lemon glass, chili paste, sugar-boiled banana puree), taste (bitterness, spiciness, saltiness, sourness, sweetness), flavor (rancid, herb, coconut milk, kaffir-lime, galangal, orange peel), texture (swallow ability, amount of particle, oily mouth feel).

Keywords: Instant tom yum, Sensory, Descriptive analysis, Flavor

1 Introduction

Tom yum is one of the most well-known Thai dishes. The distinguish characteristics of tom yum is due to the addition of various kinds of herbs such as galangal, shallots, lemon grass, and kaffir lime leaves as well as other taste components such as lime juice and tamarind, which help intensify its flavor. In addition to its flavorful quality, tom yum also exhibits several health benefits, such as cancer prevention and antioxidant properties, due to the addition of tom yum ingredients [1], [2].

The popularity of tom yum soup could be seen in the presence of tom yum essence in various products, such as instant noodles, snacks, frozen tom yum products [3], and dried seasoning [4], [5]. Today, tom yum soups and tom yum flavored products could be seen in various shelf spaces. Food manufacturers offer instant tom yum soups that are made from the basic ingredients. These instant soup products are becoming more popular in Thailand as well as in other countries around the world since it is a convenient way to obtain an authentic food. While these instant soups may offer flavorful products, it may not be exactly like that of the traditional soup that is made mostly with fresh ingredients. In addition, the processes, including heating and drying, which are used to develop these products could more or less affect the sensory components, especially the aroma of the product [6]–[8]. Instant tom yum soups that are currently available in the market can generally be grouped into three main types, soup form, powder form, and paste form. These are ready-to-cook products which generally required consumers to add water, vegetables and meat of choice prior to consuming. Each form under different brands has similar yet unique sensory characteristics. Due to the differences in the sensory components of these products, they are still called tom yum soup.

To date, there is a lack of examination of the sensory profile of instant tom yum. The aim of this study was to examine the sensory profile of commercial instant tom yum in order to determine the key attributes that make up "tom yum soup flavor".

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2 Materials and Methods

2.1 *Participants*

Eight panelists (5 females, 3 males) were selected based on the screening criteria including no allergic to food, no aversion to spiciness, availability and interest in participating in the descriptive analysis panel. The panelists were also tested to determine their ability to discriminate different intensities of basic taste solutions.

2.2 *Samples*

Twelve commercial instant tom yum soups were selected of which seven were paste-based (Pa1 to Pa7), three were powder-based (Po1 to Po3), and two were liquid-based (L1 and L2). The samples were prepared according to the instructions listed on the package. During the training sessions, 20ml of samples were served in a paper cup with three-digit random number coding. Thermos bottles were used to maintain the temperature at 45°C prior to serving. The sample evaluation sessions followed a similar serving and preparation protocol.

2.3 *Descriptive analysis*

Generic descriptive analysis was conducted to determine the sensory profile of commercial instant tom yum soups. The panelists participated in a series of training phases for 72 hours, including term generation and definition development, preparation of reference standards to form consensus understanding of the terms and their definition, score card development including discussion of anchor points for the intensity ratings of each sensory attribute, and sample evaluation. Solutions such as sucrose solution, salt solution, citric acid solution, and caffeine solution were used as reference standards for basic tastes. It should be noted that reference standards would be used if the panelists found that it was necessary. In addition, the panelists would give consensus ratings for reference standards, which were used as anchor points on the intensity scale. The panelists' performances were assessed by conducting individual evaluation sessions prior to the actual sample evaluation sessions to determine their discriminability, consistency in ratings across replications as well as across panelists. Panelists whose performance was not well would need further training in certain attributes. Upon the readiness of the panelists, actual sample evaluation sessions were performed in triplicate. Each panelist performed a total of six sessions; the twelve samples were divided into two sets of six samples and six samples were evaluated in one session in order to avoid any sensory fatigue that could occur. The judges were allowed to perform a maximum of two sessions per day in which they would be asked to take at least 30 minutes break in between sessions. Reference standards for the sensory attributes were provided as necessary and crackers and water were provided to cleanse the palate in between samples.

2.4 *Data analysis*

Analysis of variance (ANOVA) and Fisher's least significant difference test (LSD) were used to determine the significant differences between products in each sensory attribute at the level of significance of 5%. A mixed model analysis of variance was used. Principal Component Analysis (PCA) was performed to illustrate maps of sensory profile of the commercial instant tom yum soups. Statistical analyses for analysis of variance were performed using SAS 9.2 (SAS Institute, Cary, NC, USA) and principal component analysis was performed using Unscrambler 9.8 (CAMO Software AS, Oslo, Norway).

3 Result and Discussion

The descriptive analysis panel generated the attributes describing the sensory characteristics of instant tom yum soup as well as determined their definitions for each term. There were a total of 23 attributes classified into different categories including appearance, aroma, taste, flavor, and texture/mouthfeel (Table 1). Reference standards for the sensory attributes were discussed among the panelists and used upon consensus agreement in order to assist the panel to understand each attribute in the same way.

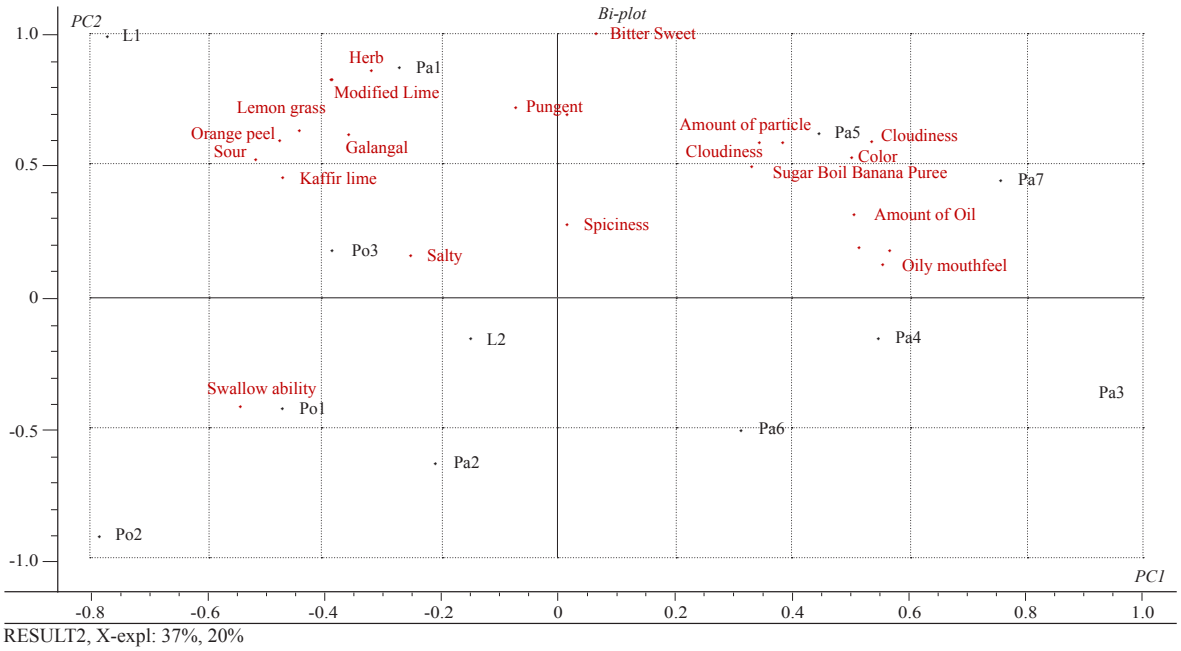
Principal Component Analysis (PCA) was performed to determine the sensory space for instant tom yum soup (Figure 1a, 1b, and 1c). It was used to generate a perceptual map of the products such that products that were similar would be grouped closely to each other while those that were different would be

Table 1: Sensory attributes and definitions for instant tom yum soup descriptive analysis

	Attribute	Definition
Appearance	Color	The actual color name describing the soup from orange to red
	Amount of Oil	The amount of oiliness on the surface of product
	Cloudiness	The amount of particle that cause the lack of clarity in the liquid
Aroma	Modified lime	Aromatic associated with artificial lime juice
	Pungent	Irritation sharp aromatic of deep fried chili
	Lemon grass	Aromatic associated with chopped fresh lemon grass
	Chili paste	Aromatic associated with sweet chili paste
	Sugar boil banana puree	Aromatic associated with Thai style banana chewy candy
	Herb	Irritation sharp sensation of herb
	Rancid	Aromatic associated with spoiled milk
Taste	Sweet	0.5%, 2%, and 5% sucrose solution
	Salty	0.3% salt solution
	Sour	0.1% citric acid solution
	Bitter	0.01% caffeine solution
Flavor	Kaffir lime	Flavor associated with fresh chopped kaffir lime
	Coconut milk	Flavor associated with pasteurized coconut milk
	Galangal	Flavor associated with fresh chopped galangal
	Orange peel	Flavor associated with dried orange peel
	Spiciness	Sensation caused by capsaicin in chilli
Texture/ Mouthfeel	Swallow ability	Easiness in swallowing the soup
	Amount of particle	Particles that are left in the mouth after swallowing the soup. Perceived by rubbing the tongue and palate
	Oily mouthfeel	Sensation of the presence of thin immiscible liquid in the oral cavity

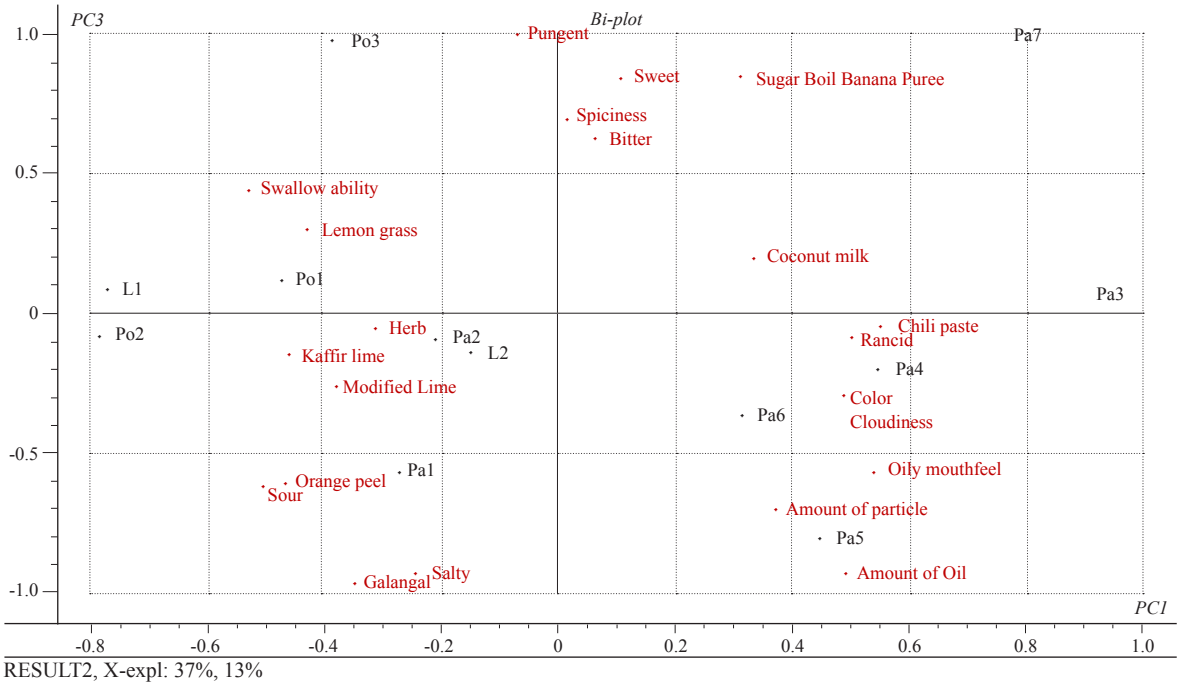
far apart indicating the relationship among products [9]. In addition, the perceptual map also provided information about the sensory attributes in the same manner, which could be used to describe the characteristics of different groups of products.

The first three Principal Components (PC) were retained for interpretation as a total of 70% of the variation in the data would be explained by PC 1 (37%), PC 2 (20%), and PC 3 (13%). Each PC would be described by particular relating sensory attributes and could contribute in explaining the similarities and differences between the instant tom yum soups. The instant tom yum soups were characterized based on their similarities and differences in sensory characteristics. Principal Component 1 was described mainly by the appearance and texture/mouthfeel attributes such as color, cloudiness, amount of oil, swallowability, oily mouthfeel, and amount of particle as well as two other aroma attributes, chili paste and rancid. This illustrated that the appearance and texture/mouthfeel attributes were correlated and that they could explain the maximum variation in the data. In other words, these attributes contributed to the main differentiation of the instant tom yum soups. Principal Component 2 was described by aroma and flavor attributes such as modified lime, herb, and coconut milk. The key aroma and flavor attributes including lemon grass, kaffir lime, galangal, and orange peel could describe both PC1 and PC2. These aroma and flavor were originated from the main ingredients of tom yum, with the exception of orange peel. Principal Component 3 was mainly described by spiciness flavor. The sensory characteristics of taste including sweet and bitter would well describe Both PC2 and PC3. Pungency aroma was an aroma attribute that was described by these two principal components.



RESULT2, X-expl: 37%, 20%

Figure 1a: Principal component analysis (PCA) of instant tom yum soup samples and the sensory attributes on PC1 and PC2.



RESULT2, X-expl: 37%, 13%

Figure 1b: Principal component analysis (PCA) of instant tom yum soup samples and the sensory attributes on PC1 and PC3.

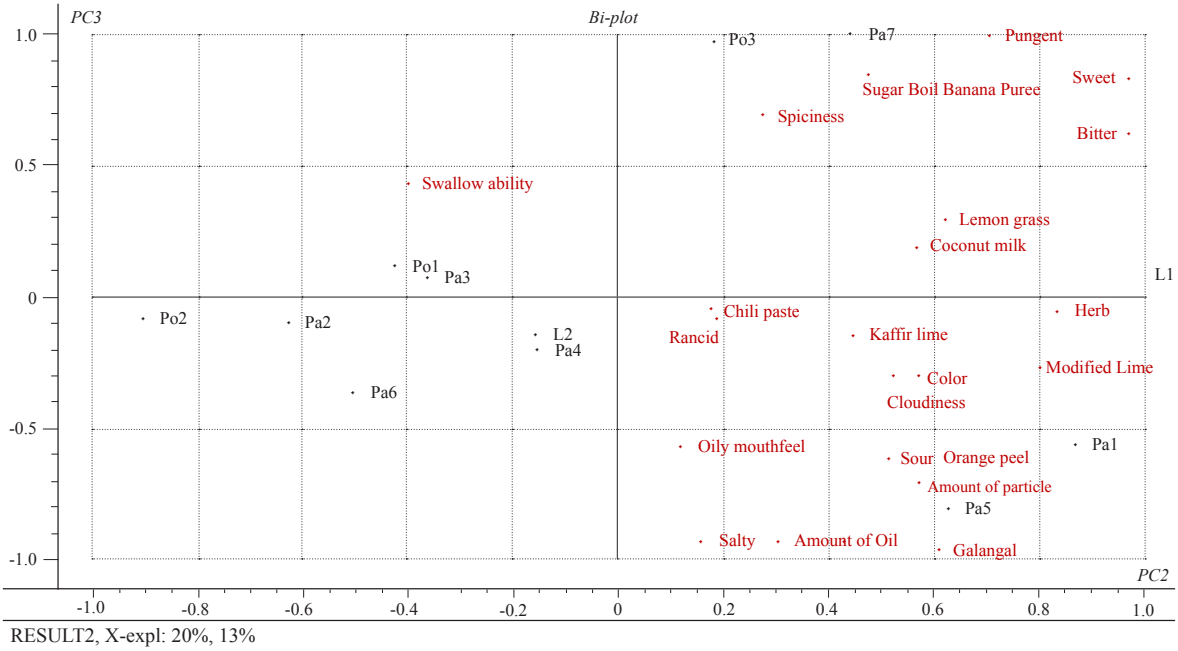


Figure 1c: Principal Component Analysis (PCA) of instant tom yum soup samples and the sensory attributes on PC2 and PC3.

The largest differences between the twelve tested instant tom yum soups were the characteristics related to appearance and texture/mouthfeel of the soups. The mean intensity ratings for each instant tom yum soup sample across sensory attributes were shown in Table 2. These attributes mainly differentiated the differences between the paste-based instant tom yum soups from those made from powder and liquid bases. The paste-based instant tom yum soup tended to have high intensity of appearance attributes including orange color, cloudiness, and amount of oil as well as higher intensity of oily mouthfeel, amount of particle and harder to swallow.

The mixture in paste-based instant tom yum soup was rather coarse and did not completely dissolve in water, which consequently affected the amount of particles, cloudiness of the soup and the ability to swallow. Paste-based instant tom yum soups generally contain a high amount of oil from chili paste, which resulted in high intensity of oil-related attributes. The chili paste was commonly prepared by frying chili in oil. The presence of lipids in food including as a form of oil or as a form of fat constituent in food could provide desirable sensory properties to the food [10]–[12]. In this case, it contributed to the appearance and texture/mouthfeel properties. Despite of that, the presence of oil in the paste-based instant tom yum soup could be a factor that contributed to rancid aroma and thus the panelists were able to detect high rancidity in these samples. Various processing methods, such as frying, drying and other thermal processing could cause lipid oxidation in products [13]–[16]. In contrast to the paste-based instant tom yum soups, the powder-based and liquid-based instant tom yum soups tended to have lighter color, lower amount of particles and oil. The powder-based instant tom yum soups were easier to swallow since the components completely dissolved in water during preparation.

Despite the importance of appearance and texture/mouthfeel attributes in describing instant tom yum soups, aroma and flavor attributes could also be used to group similar instant tom yum soups together and separate those that were different. Generally, the main differences in aroma and flavor could also be used to distinguish between paste-based and liquid-based or powder-based instant tom yum soups.

Table 2: Mean intensity ratings for instant tom yum soups across sensory attributes

Sample	Pa1		Pa2		Pa3		Pa4		Pa5		Pa6		Pa7	
Color	4.9±0.8	F	2.8±0.7	H	12.7±0.6	A	5.5±0.5	E	12.3±0.6	B	8.1±0.7	C	8.0±0.5	C
Amount of Oil	8.0±1.1	C	2.6±0.9	G	11.3±0.8	A	9.5±0.5	B	11.4±0.5	A	7.7±0.7	D	3.8±0.4	E
Cloudiness	6.9±0.9	FG	3.0±0.6	J	11.1±0.7	I	9.6±0.6	B	11.9±0.5	C	8.5±0.7	A	7.4±0.8	K
Modified Lime	3.5±0.6	C	1.0±0.6	G	0.4±0.4	H	1.7±0.6	F	2.9±0.4	D	1.4±0.4	F	2.2±0.7	E
Pungent	3.2±0.6	D	1.2±0.6	G	5.6±0.8	C	2.5±0.5	E	2.6±0.8	E	1.7±0.6	F	5.8±1.1	C
Lemon grass	3.1±0.5	D	1.1±0.3	H	0.8±0.6	I	1.5±0.7	G	2.2±0.5	E	1.9±0.6	FE	1.5±0.5	G
Chili paste	3.2±0.6	C	1.4±0.7	FG	10.2±1.2	A	2.8±0.9	D	5.6±0.6	B	2.9±0.9	DC	5.7±0.5	B
Sugar boil banana puree	0.8±0.5	C	0.1±0.3	F	0.5±0.5	D	0.2±0.4	EF	1.1±0.7	B	0.4±0.5	ED	3.6±0.6	A
Herb	3.8±0.9	A	2.4±0.5	C	1.5±0.5	F	0.9±0.6	H	2.0±0.5	D	1.9±0.7	D	1.4±0.5	GF
Rancid	1.7±0.7	ED	1.9±0.5	CBD	1.5±0.7	FE	2.9±0.5	A	1.9±0.6	CD	2.3±0.6	B	0.8±0.7	G
Sweet	2.3±0.5	CBD	1.3±0.4	E	1.9±0.6	CD	2.2±0.7	CBD	2.1±0.5	CD	2.0±0.7	CD	3.6±1.4	A
Salty	2.3±0.6	CB	2.7±0.6	B	1.6±1.2	E	1.9±0.9	ED	3.3±0.9	A	1.7±0.6	ED	1.7±0.8	ED
Sour	3.7±0.6	A	2.9±0.5	B	1.2±1.0	F	1.8±0.7	D	3.3±0.5	B	1.7±0.9	ED	1.4±1.1	EF
Bitter	1.2±0.4	ECD	1.2±0.4	BCD	0.8±0.8	GF	1.0±0.9	EFD	1.6±0.7	BA	0.3±0.5	H	1.9±0.5	A
Kaffir lime	2.8±0.9	C	1.2±0.4	G	2.1±0.7	D	1.6±0.6	EF	1.8±0.7	ED	2.7±0.9	D	3.3±0.8	B
Coconut milk	1.3±0.9	CB	1.0±0.5	C	0.6±0.8	D	0.5±0.8	ED	1.5±0.7	B	1.5±0.5	B	0.2±0.4	E
Galangal	2.9±0.8	BC	1.9±0.8	F	2.0±0.8	FE	1.8±0.7	FG	1.8±0.8	F	3.1±0.6	BA	2.7±0.6	DC
Orange peel	2.1±0.8	A	1.5±0.5	BCD	1.0±0.7	EF	0.4±0.6	G	0.9±1.0	EF	1.2±0.6	ECD	1.2±0.5	ED
Spiciness	3.6±0.8	B	1.3±0.4	GFH	3.2±0.4	C	3.1±1.1	C	1.6±0.7	GF	2.5±0.5	D	0.7±0.4	I
Swallow ability	4.0±0.6	G	5.4±0.6	E	3.9±0.5	HG	2.8±0.9	I	3.6±0.6	H	4.3±0.7	G	3.1±0.5	I
Amount of particle	8.5±0.7	B	3.7±0.6	E	3.6±0.6	FE	8.2±0.8	C	9.9±0.8	A	7.8±0.8	C	8.0±0.9	C
Oily mouthfeel	6.7±0.5	D	4.2±1.2	G	11.1±0.7	A	10.3±0.7	B	6.9±0.5	D	9.4±0.5	C	6.0±0.7	E

Note: Different letters indicate significant differences between samples in a sensory attribute ($p < 0.05$).

Table 2: (Continued) Mean intensity ratings for instant tom yum soups across sensory attributes

Sample	Po1		Po2		Po3		L1		L2	
Color	2.4±0.6	I	0.2±0.4	J	4.0±0.6	G	7.3±0.5	D	4.7±0.7	F
Amount of Oil	1.6±0.4	H	0.2±0.4	J	0.9±0.6	I	2.9±0.6	GF	3.2±0.6	F
Cloudiness	2.6±0.6	G	1.6±0.5	H	7.2±0.9	D	6.7±0.6	E	4.1±0.5	FE
Modified Lime	2.0±0.4	E	8.0±0.8	B	2.1±0.6	E	9.3±0.6	A	2.8±0.6	D
Pungent	1.33±0.7	GF	3.1±0.7	D	8.0±0.8	B	9.2±1.3	A	2.5±0.5	E
Lemon grass	5.4±0.7	B	2.0±0.5	FE	4.4±0.8	C	7.7±0.4	A	1.7±0.4	FG
Chili paste	1.5±0.5	FE	0.7±0.4	H	1.2±0.4	G	1.6±0.5	FE	1.7±0.6	E
Sugar boil banana puree	0.3±0.4	EDF	0.2±0.3	F	0.8±0.4	C	0.1±0.3	F	0.4±0.5	D
Herb	2.5±1.2	CB	1.9±0.6	ED	1.1±0.5	GH	1.5±0.6	EF	2.8±0.9	B
Rancid	1.2±0.7	F	1.7±0.4	ED	1.2±0.7	FG	2.0±1.1	CB	1.3±0.5	FE
Sweet	1.8±1.0	D	1.1±0.5	E	2.7±1.3	B	3.4±1.0	A	2.3±1.0	CB
Salty	2.4±1.1	CB	2.6±0.8	B	1.8±0.8	ED	2.3±0.7	CB	2.1±0.6	CD
Sour	3.2±0.9	B	3.0±0.9	B	2.5±0.7	C	3.8±0.8	A	2.3±0.7	C
Bitter	0.8±0.5	EF	0.5±0.7	GH	1.4±0.7	BC	1.6±1.0	BA	1.0±0.6	EFD
Kaffir lime	4.2±1.0	A	2.9±0.6	C	1.7±0.4	E	1.3±0.7	GF	2.89±0.7	C
Coconut milk	0.5±0.5	ED	0.6±0.6	D	0.42±0.5	ED	2.3±0.6	A	0.5±0.5	ED
Galangal	3.5±0.7	A	2.5±0.5	D	2.4±0.7	DE	1.4±0.5	G	2.1±0.8	FE
Orange peel	1.8±1.0	BA	1.6±0.7	BC	1.2±0.6	ECD	0.7±0.6	GF	1.2±0.7	E
Spiciness	1.2±0.4	GH	1.2±0.5	H	1.7±0.5	F	2.1±0.8	E	7.5±0.5	A
Swallow ability	9.6±0.6	B	10.7±0.8	A	8.5±0.7	C	7.5±0.5	D	4.6±0.4	F
Amount of particle	2.2±0.5	H	1.5±0.6	I	2.8±0.5	G	3.3±0.5	F	7.0±0.6	D
Oily mouthfeel	1.8±0.5	I	1.3±0.5	J	2.2±0.4	H	4.4±0.5	GF	4.7±0.6	F

Note: Different letters indicate significant differences between samples in a sensory attribute ($p < 0.05$).

Both the liquid-based and powder based instant tom yum soups have higher intensity of lemon grass, modified lime and herb aroma, kaffir lime, galangal and orange peel flavor when compared to paste-based instant tom yum soups. This could be due to the amount of oil content in the paste-based instant tom yum soups that trapped the aroma and flavor release of the tom yum ingredients. It was found that a lesser concentration of volatile compounds were released in the presence of lipids [17]. In addition, the presence of rancid aroma caused from fat oxidation could also mask the other key aroma and flavor sensory characteristics. Despite the fact that one of the liquid-based instant tom yum soups showed a significantly high intensity of some key aroma and flavor attributes, the other liquid-based sample did not show remarkably high intensities of any particular sensory attributes.

Thai foods are generally known for its spiciness and this is not the exception of tom yum. According to the PCA obtained from this study, spicy flavor was one of the characteristics that could be used to separate some instant tom yum soups from others. Although all of the samples included in this experiment had some degree of spiciness, one of the powder-based instant tom yum soups had a significantly high intensity of spicy flavor ($p < 0.05$). Spiciness attribute was not the key attribute in used in the differentiation of the three forms of instant tom yum soup since not all powder-based instant tom yum soups resulted in high intensity of such attribute. The other instant tom yum samples had a relatively low intensity of spiciness. The taste component, including sweet, sour, salty, and bitter, did not seem to play an important role in discriminating various instant tom yum soups. Furthermore, some attributes that were identified to be used to describe the sensory characteristics of instant tom yum soups tended to be a part of a sensory profile of certain instant tom yum soups rather than providing a differentiation between forms of instant tom yum soups. For example, pungent aroma was one of the main sensory characteristics of L1 and Po3; sugar-boiled banana puree could be used to describe Pa7.

4. Conclusions

The sensory profile of commercial instant tom yum soup from three different forms (paste, powder, and liquid) was determined. The appearance and texture/mouthfeel characteristics largely contribute to the differentiation of paste-based, powder-based, and liquid-based instant tom yum soups. The powder-based and liquid-based instant tom yum soups tended to have intense aroma and flavor components of herbal ingredients such as kaffir lime leaves and galangal than paste-based instant tom yum soups, which tended to be more intense in the orange-red color and high amount of oil with less intense in such aroma and flavor components. Distinctive sensory profiles of each type of instant tom yum soups could suggest different usage situation, which could be important for manufacturers in positioning their products. Further investigation in consumer preference for instant tom yum soups is being investigated.

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