International Journal of Agricultural Technology 2022Vol. 18(1):35-48
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

Effect of carboxymethylcellulose and xanthan gum on the physicochemical and sensory properties of passion fruit topping sauces

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Boonditsataporn, L. and Vatthanakul, S. (2022). Effect of carboxymethylcellulose and xanthan gum on the physicochemical and sensory properties of passion fruit topping sauces. International Journal of Agricultural Technology 18(1):35-48.

Abstract In food industry, hydrocolloid is the food additive that widely used in food product as a stabilizer, thickener, emulsifier, or gelling agent for improve the properties of food products. Over the last year, the food industry has begun to apply more than one type of hydrocolloid into food products to obtain benefits in various fields, whether used to develop a formula, enhance nutrition, enhance values, or reduce production costs. This research studied on effect of use of some hydrocolloids alone or in combinations on the quality of passion fruit topping sauces that was acceptable to consumers. The research determined the effects of carboxymethylcellulose (CMC) and xanthan gum in various ratios (1.00:0.00, 0.75:0.25, 0.50:0.50, 0.25:0.75 and 0.00:1.00) on the quality of passion fruit topping sauces. The result showed that increasing the ratio of xanthan gum and decreasing the ratio of CMC tended to increased the appearant viscosity, firmness, consistency, index of viscosity, and color parameter (L*, a* and b*) of passion fruit topping sauce, but decreased in pH values. In terms of sensory, from the quantitative descriptive analysis showed that increasing the ratio of xanthan gum resulting in increased intensity score of viscosity in mouthfeel and decreased intensity score of passion fruit flavor, and smoothness of passion fruit topping sauce. In addition, the consumer preference test founded that ratio of CMC and xanthan gum at 0.50:0.50 had a highest overall liking score and just about right in terms of viscosity of passion fruit topping sauce. In general, these hydrocolloids gave a good quality of topping sauces in terms of texture properties when they were used with combinations rather than being used individually. The using of CMC combination with xanthan gum would be the interesting ingredient for improvement viscosity and consistency of the topping sauce product or other sauce products.

Keywords: Passion fruit, Topping sauce, Quantitative Descriptive Analysis, Xanthan gum, CMC

Introduction

Food Hydrocolloids are large molecules that have the ability to suspend and bind with water molecules. Hydrocolloid compounds have been widely

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used in the food industry to improve food texture, such as using them as viscosity agents, gelling agents, fat substitutes, and stabilizing agents. Using hydrocolloids at 1.0% concentrations can also affect food texture and sensory quality (Williams and Phillips, 2000). Food hydrocolloids can be produced from various sources, such as plants, animals, algae, and microorganisms. In the food industry, they usually use hydrocolloids in more than one type of food for development and to reduce costs. When using two or more hydrocolloids in food, sometimes it can cause synergistic effects and antagonistic effects in food (Karaman *et al.,* 2014). Accordingly, the synergistic effects should also be considered in food products.

Carboxymethyl cellulose (CMC), or cellulose gum, is an anionic cellulose derivative. CMC can be dissolved in hot or cold water and has the ability to absorb water well. The most stable and highest viscosity to use in food is close to neutral pH values. The rheological properties of CMC solutions depend on various factors such as concentration, molecular weight, degree of substitution (DS), dispersion, or the environment of the food system. CMC solution displays Newtonian-flow behavior at a low concentration (less than 5%) when at a higher concentration that displays non-Newtonian flow behavior (pseudoplastic flow behavior) and viscoelastic properties (Benchabane and Bekkour, 2018). CMC is used in various food products that depend on the functionalities that are used in those products, such as enhancing the stability of turbidity in juice (Linh *et al.,* 2019), reducing syneresis and thickening in ketchup (Gujral *et al.,* 2002; Sahin and Ozdemir, 2004), and stabilizing acidified milk drinks (Yuliarti *et al.,* 2019).

Xanthan gum is an anionic hydrocolloid that is produced by Xanthanmonas campestris. The main structure of xanthan gum consists of a 1,4-D-glucose polymer and a branched structure that consists of 2 D-mannose and D-glucuronic acid, where the terminal of D-mannose contains pyruvic acid residual (Nussinovitch, 1997). The rheological properties of xanthan gum solution had flow behavior that was non-Newtonian flow behavior like pseudoplastic flow behavior (shear-thinning fluids). Xanthan gums are stable over a wide pH range and are resistant to salt solutions. Previous research has found a concentration of xanthan gum that is used in viscous food models. It affected the release of some volatile compounds in food. Xanthan gum can also decrease the release of volatile compounds due to the interaction between xanthan gum and volatile compounds (Bylaite *et al*., 2005). Moreover, using xanthan gum in food has low pH values. It can prevent the degradation of anthocyanin by ascorbic acid by bonding with hydrogen bonds and hydrophobic interactions between xanthan gum and anthocyanin (Zhao *et al.,* 2020). In the food industry, xanthan gum has been widely used in food products

that depend on the functionalities that are applied in food, such as enhancing stability in beverages (Paquet *et al.,* 2014), using as a thickening agent in syrup and fruit sauce (Pongsawatmanit *et al.,* 2011; Rahman and Thajudin, 2015; Yalçınöz and Erçeleb, 2016), reducing syneresis of ketchup (Gujral *et al.,* 2002), and using as stabilizer and emulsifier in dairy product (Sworn, 2010; Zhao *et al.,* 2009).

The objective of this research was to study the effect of the combination of CMC and xanthan gum at different ratios on the quality of the physicochemical and sensory properties of the passion fruit topping sauce. The sensory evaluation was carried out by determining the quantitative descriptive analysis (QDA) and preference test in terms of the viscosity of the passion fruit topping sauce.

Materials and methods

Materials

Ingredients for the passion fruit topping sauce were bought, frozen seedless passion fruit puree (Aro®), sucrose (Mitr Phol®), salt (Prungthip®), citric acid, sodium benzoate (Thai Food and Chemical CO., LTD.), xanthan gum (Deosen®, Deosen Biochemical Ltd.) and sodium carboxymethylcellulose (CMC) (ANHUI EBUY INTERNATIONAL Co., Ltd.).

Passion fruit topping sauce preparation

Frozen passion fruit puree was thawed, and all ingredients were weighed as followed in Table 1. Sugar, salt, xanthan gum and sodium CMC were mixed, dissolved, and stirred them in at 60-65 ℃ until completely dissolved. Then, passion fruit puree and the mixture that had already dissolved were added into hot mixer (HotmixerPro Easy, Italy). The mixture was boiled at 80 ℃ and stirred for 10 minutes. Then citric acid, and sodium benzoate were added to the mixture and boiled for 2 minutes. Passion fruit topping sauces at 80 ℃ were filled into clean spout pouch and soaked in ice for 40 minutes. The Passion fruit topping sauces was then transferred to a sterilized container and stored under refrigeration at 4^{o}C.

Physicochemical test

The physicochemical properties of passion fruit topping sauces were determined pH with pH meter (Mettler Toledo Seven2Go Pro S8, China), color

parameter (L*, a* and b*) with color meter (Hunter Lab CX2687, USA), Total soluble solids (TSS) with refractometer (Milwaukee MA871, Romania), and viscosity with Brookfield viscometer (RVDV-II+ Viscometer, USA). For the viscosity was carried out by using small sample adapter with SC4-21 that used 8 ml of samples and determined at shear rate 18.6 s^{-1}. Texture of sample was tested by Texture analyzer (Stable micro system TA-XTPlus, UK) via Back extrusion cell (A/BE). Firstly, prepared sample 100 g and filled into container (dimension 50 mm,). For the spindle, used spindle dish that dimension 35 mm. The setup test was carried out by following this mode: Compression, pre-test speed 1.00 mm s^{-1}, test-speed 1.0 mm s^{-1}, distance 30 mm and trigger force 5 g. The parameters from the texture analyzer were analysed in terms of firmness (g), consistency (g s^{-1}), cohesiveness (g), and index of viscosity (g s^{-1}). The sample was determined by three replicate measurements for all parameters.

Table 1. Ingredients of passion fruit topping sauce that different ratio of CMC and Xanthan gum

Ingredient	CMC : Xanthan gum				
	1.00 : 0.00	**0.75 : 0.25**	**0.50 : 0.50**	**0.25 : 0.75**	**0.00 : 1.00**
Passion fruit puree	360.00	360.00	360.00	360.00	360.00
Water	397.20	397.20	397.20	397.20	397.20
Salt	1.80	1.80	1.80	1.80	1.80
Sugar	230.00	230.00	230.00	230.00	230.00
Xanthan gum	0.00	1.50	3.00	4.50	6.00
CMC	6.00	4.50	3.00	1.50	0.00
Citric acid	4.20	4.20	4.20	4.20	4.20
Sodium benzoate	0.80	0.80	0.80	0.80	0.80

Quantitative descriptive analysis

The passion fruit topping sauces were evaluated by using quantitative descriptive analysis (QDA) with 10 trained panelists (age between 23 and 27 years old) that were recruited for this test. Before the test, the assessors generated, discussed, modified, and trained in descriptive terms by using a 15-cm intensity scale. The sensory attributes evaluated were transparency, orange color, passion fruit aroma, passion fruit flavor, sweetness, sourness, saltiness, viscosity in mouthfeel, and smoothness. The attributes are modified descriptive terms that are shown in Table 2.

For the sensory evaluation of passion fruit topping sauce was carried out in the sensory laboratory at the department of Food Science and Technology, Thammasat University. The consumers were given samples of 15 g placed in lidded transparent containers which were accompanied with unsalted crackers and room temperature water for palate cleansing purposes between sample tasting. Panelists evaluated intensities and scored each attribute on a 150 mm. unstructured, 2 words anchored at 12.5 mm and 137.5 mm, corresponding to weak and strong for all attributes on a line scale.

Table 2. Definition of sensory attribute terms for the evaluation of passion fruit topping sauce

Attributes	Descriptor	Definition	Low	High
Appearance	Transparency	The transparency from turbid to clear.	Turbidity	Clear
	Orange color	The intensity or strength of the orange color from dull to bright.	Dull	Bright
Aroma	Passion fruit aroma	Aroma sensation related to the passion fruit.	None	Strong
Flavor	Passion fruit flavor	Gustatory sensation related to the intensity of the passion fruit flavor.	None	Strong
Taste	Sweetness	The taste stimulated by sucrose.	None	Strong
	Sourness	The taste stimulated by citric acid.	None	Strong
	Saltiness	The taste stimulated by salt.	None	Strong
Texture	Viscosity in mouthfeel	The viscosity that perceives by tongue and palate.	Thinness	Thickness
	Smoothness	The smooth of sample that perceives by tongue.	Roughness	Smoothness

Preference test

The preference test, passion fruit topping sauces was evaluated in attribute of appearance, color, aroma, flavor, texture, taste, and overall liking with 50 untrained panelists. They were asked to state their degree of preference by using a 9 – point hedonic scale for each of the passion fruit topping sauces to identify product attributes that determine preference (Lawless and Heyman, 1998). The 15 g of passion fruit topping sauce was presented in white plastic cups that had a coded three-digit number which were accompanied with bread, unsalted crackers, and room temperature water for palate cleansing purposes between sample tasting. Moreover, panelists were rated the same passion fruit topping sauce samples on a 5-point JAR scale (1 = much too low, 2 = a little

too low, 3 = just about right, 4 = a little too much, and 5 = much too much) in term of viscosity in mouthfeel. The sensory evaluation of the passion fruit topping sauce was carried out in a central location in the Thammasat University area.

Statistical analysis

All data were calculated from the average of three replicate measurements. Data were analyzed for analysis of variance (ANOVA) and the significance of their variations was verified by means of Duncan's multiple range test ($p < 0.05$). For data from the JAR test, it was analyzed by using Binomial's test (Meilgaard *et al.*, 1999).

Results

Physicochemical test

The effect of using a different ratio of CMC and xanthan gum on the physicochemical properties of the passion fruit topping sauce is shown in table 3. The passion fruit topping sauce with a different ratio of CMC and xanthan gum was total soluble solids did not significantly differ among all samples ($p \geq 0.05$), but the pH values, color parameters (L*, a*, and b*), apparent viscosity, firmness, consistency, cohesiveness, and index of viscosity had a significant difference. The pH value of the passion fruit topping sauce decreased significantly ($p < 0.05$) when the ratio of CMC was decreased, and xanthan gum was increased in the passion fruit topping sauce. The lowest pH value was 2.74 (0.00:1.00) and the highest pH value was 2.95 (1.00:0.00). For the color parameters (L*, a*, and b*) the apparent viscosity, firmness, consistency, cohesiveness, and index of viscosity of the passion fruit topping sauce increased significantly ($p < 0.05$) when the ratio of CMC was decreased, and xanthan gum was increased. The passion fruit topping sauce had CMC only (1.00:0.00) that had the lowest value of L* (10.95), a* (2.18), b* (9.64), apparent viscosity (714.17 cP), firmness (14.46 g), consistency (301.54 g s^{-1}), cohesiveness (15.16 g), and index of viscosity (4.17 g s^{-1}), whereas the passion fruit topping sauce had xanthan gum only (0.00:1.00) that had the highest value of L* (14.79), a* (4.34), b*(14.97), apparent viscosity (1,913.33 cP), firmness (35.72 g), consistency (828.82 g s^{-1}), cohesiveness (24.41 g), and index of viscosity (37.42 g s^{-1}).

Table 3. The properties of the passion fruit topping sauce at various ratios of CMC and xanthan gum

Physicochemical properties	CMC : Xanthan gum				
	1.00 : 0.00	0.75 : 0.25	0.50 : 0.50	0.25 : 0.75	0.00 : 1.00
Apparent viscosity (cP)	714.17d ± 116.37	838.67d ± 117.68	1005.08c ± 116.81	1323.75b ± 206.07	1913.33a ± 104.41
L*	10.95c ± 0.16	12.13b ± 0.77	14.01a ± 1.44	14.83a ± 0.97	14.79a ± 0.97
a*	2.18c ± 0.36	2.33c ± 0.39	3.39b ± 0.33	3.22b ± 0.57	4.34a ± 0.59
b*	9.64b ± 0.77	9.38b ± 0.25	14.94a ± 4.25	14.57a ± 4.37	14.97a ± 1.11
pH	2.95a ± 0.03	2.90b ± 0.02	2.87c ± 0.01	2.82d ± 0.01	2.74e ± 0.01
TSS (℃Brix) ns	30.82 ± 0.23	30.70 ± 0.76	30.48 ± 0.30	30.80 ± 0.19	30.73 ± 0.10
Firmness (g)	14.46e ± 0.48	15.62d ± 0.43	18.07c ± 0.48	25.57b ± 1.60	35.72a ± 0.82
Consistency (g s-1)	301.54e ± 7.46	328.07d ± 11.14	395.45c ± 2.73	569.16b ± 32.77	828.82a ± 28.98
Cohesiveness (g)	15.16a ± 0.64	15.49a ± 0.72	17.22b ± 0.63	20.27c ± 0.71	24.41d ± 1.13
Index of viscosity (g s-1)	4.17a ± 1.12	4.69a ± 0.93	11.65b ± 0.75	21.87c ± 1.02	37.42d ± 4.64

[a-d] Means within the same row followed by the different letters are significantly different ($p < 0.05$).
[ns] Means within the same column followed by the different letters are not significantly different ($p \geq 0.05$).

Table 4. Sensory evaluation of the passion fruit topping sauces

Attribute	CMC : Xanthan gum				
	1.00 : 0.00	**0.75 : 0.25**	**0.50 : 0.50**	**0.25 : 0.75**	**0.00 : 1.00**
Transparency [ns]	9.35 ± 1.11	9.25 ± 1.07	9.23 ± 1.19	9.25 ± 1.51	9.44 ± 1.51
Color [ns]	4.50 ± 0.69	4.65 ± 0.77	4.54 ± 0.92	4.69 ± 0.72	4.60 ± 0.63
Passion fruit aroma [ns]	8.19 ± 1.60	8.10 ± 1.58	7.96 ± 1.29	8.13 ± 1.64	8.08 ± 1.32
Passion fruit flavor	8.03[a] ± 1.07	8.10[a] ± 1.29	7.63[ab] ± 1.19	7.75[ab] ± 1.25	7.15[b] ± 1.50
Sweetness [ns]	8.94 ± 1.62	8.69 ± 1.57	8.73 ± 1.64	8.25 ± 1.64	8.23 ± 1.45
Sourness [ns]	8.38 ± 1.56	8.71 ± 1.42	8.69 ± 1.65	8.48 ± 1.56	8.63 ± 1.29
Saltiness [ns]	1.00 ± 1.19	1.04 ± 1.26	1.19 ± 1.27	0.96 ± 1.28	0.96 ± 1.12
Viscosity in mouthfeel	2.75[c] ± 1.00	3.08[bc] ± 1.48	3.50[b] ± 1.22	4.27[a] ± 1.35	4.66[a] ± 1.50
Smoothness	11.69[a] ± 1.45	11.31[ab] ± 1.47	11.21[ab] ± 1.50	10.60[bc] ± 1.62	10.08[c] ± 1.69

[a-c] Means within the same row followed by the different letters are significantly different ($p < 0.05$).
[ns] Means within the same column followed by the different letters are not significantly different ($p \geq 0.05$).

Quantitative descriptive analysis

The quantitative descriptive analysis of the passion fruit topping sauce was shown in Table 4. It was found that the sensory characteristics of the attribute of transparency, orange color, passion fruit aroma, sweetness, sourness, and saltiness were not significantly different between the samples ($p \geq 0.05$), but in terms of passion fruit flavor, viscosity in mouthfeel, and smoothness, there were significant differences between the samples ($p < 0.05$). The intensity of passion fruit flavor and smoothness that perceived by an assessor, there were decrease when the ratio of CMC was decrease, and xanthan gum was increased. The intensity of passion fruit flavor and smoothness, as perceived by an assessor, decreased when the ratio of CMC was decreased, and xanthan gum was increased. The passion fruit topping sauce had CMC only (1.00:0.00) that had the highest intensity score of passion fruit flavor (8.03) and smoothness (11.69), while the passion fruit topping sauce had xanthan gum only (0.00:1.00), it had the lowest intensity score of passion fruit flavor (7.15) and smoothness (10.08). For the attribute of viscosity in mouthfeel that was perceived by an assessor, it was increased when the ratio of CMC was decreased, and xanthan gum was increased in the passion fruit topping sauce. The passion fruit topping sauce had CMC only (1.00:0.00) that had the lowest intensity score of viscosity in mouthfeel (2.75), whereas the passion fruit topping sauce had xanthan gum only (0.00:1.00) that had the highest intensity score of viscosity in mouthfeel (4.66).

Table 5. Mean hedonic score of passion fruit topping sauce

Attribute	CMC : Xanthan gum				
	1.00 : 0.00	**0.75 : 0.25**	**0.50 : 0.50**	**0.25 : 0.75**	**0.00 : 1.00**
Appearance	$6.24^{b} \pm 1.66$	$5.82^{c} \pm 1.53$	$6.80^{a} \pm 1.40$	$6.36^{b} \pm 1.52$	$6.36^{b} \pm 1.55$
Color ^{ns}	6.50 ± 1.56	6.46 ± 1.18	6.88 ± 1.22	6.76 ± 1.57	6.76 ± 1.31
Flavor ^{ns}	6.64 ± 1.61	6.54 ± 1.47	6.78 ± 1.63	6.34 ± 1.65	6.30 ± 1.71
Texture	$5.92^{b} \pm 1.72$	$5.66^{b} \pm 1.45$	$6.60^{a} \pm 1.32$	$6.08^{b} \pm 1.69$	$5.64^{b} \pm 1.76$
Taste	$6.56^{ab} \pm 1.85$	$6.32^{b} \pm 1.41$	$6.96^{a} \pm 1.19$	$6.24^{b} \pm 1.59$	$6.24^{b} \pm 1.57$
Overall liking	$6.34^{b} \pm 1.64$	$6.36^{b} \pm 1.14$	$6.94^{a} \pm 1.22$	$6.16^{b} \pm 1.40$	$6.16^{b} \pm 1.53$

$^{a-c}$ Means within the same row followed by the different letters are significantly different ($p < 0.05$).
^{ns} Means within the same column followed by the different letters are not significantly different ($p \geq 0.05$).

Preference test

A preference test was carried out by collecting data from 50 respondents (Table 5). The result shows each sample had a significant difference in appearance, texture, taste, and overall liking ($p < 0.05$). In terms of color and flavor, there was no significant difference in 9-point hedonic scores ($p \geq 0.05$).

The passion fruit topping sauce, with a ratio of CMC and xanthan gum of 0.50: 0.50, had the highest score attribute of overall liking (6.94). In addition, the passion fruit topping sauce was made by using just-about-right (JAR) in terms of viscosity in mouthfeel (Figure 1). The result shows all samples had a JAR score (3 = just about right) less than 70%. From Binomial's test, it was found that only one sample was just about right in terms of viscosity in mouthfeel. That was the passion fruit topping sauce, which had a ratio of CMC and xanthan at 0.50: 0.50.

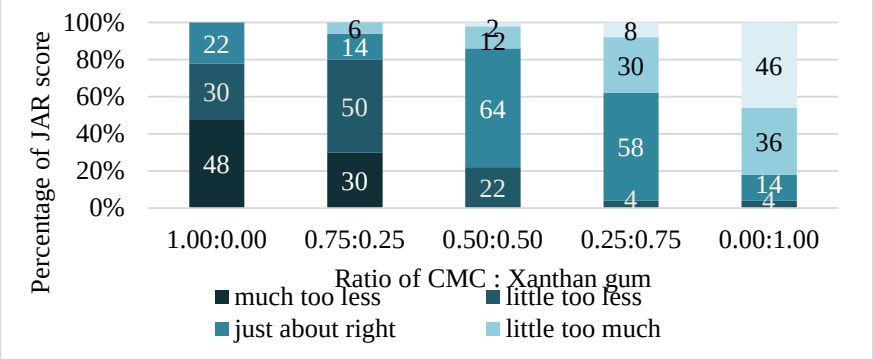

Figure 1. Distribution of JAR scale of the passion fruit topping sauces

Discussion

Physicochemical properties

The effect of CMC and xanthan gum of the passion fruit topping sauce on physicochemicals was determined. The decreased pH value of the passion fruit topping sauce is a result of the breakdown of pyruvic acid in the molecule structure of xanthan gum. From the molecular structure of xanthan gum, when pH values in the system are less than 3.0, xanthan gum can also lose pyruvic acid from this structure (Bradshaw *et al.*, 1983), so as the increased ratio of xanthan gum concentration in passion fruit topping sauce, the amount of pyruvic acid released from the structure increases as well. As a result, the pH value in the passion fruit topping sauce was decreased.

The change in color value of the passion fruit topping sauce may be due to interaction between color pigments in the passion fruit topping sauce and hydrocolloid compounds. In previous research by Zhao *et al.* (2020), they found the effect of xanthan gum on the color stability of anthocyanin in acid beverage products. The stability of anthocyanin increased when the xanthan gum concentration was higher in the sample. The increase in color stability was due to the interaction between xanthan gum and anthocyanin. This interaction prevents the degradation of anthocyanins from the ascorbic by hydrogen bonding or hydrophobic interaction between anthocyanins and xanthan gum.

Accordingly, a change in color occurred in the passion fruit topping sauce because of the change in anthocyanin. It is possible that this event occurs due to the passion fruit's containing anthocyanin as a colorant (Dhawan *et al.*, 2004).

The change in the apparent viscosity of the passion fruit topping sauce. According to research by Pongsawatmanit *et al.* (2011), they studied the effect of using xanthan gum as a substitute for modified tapioca starch on the viscosity quality of blueberry syrup. It was found the concentration of xanthan gum was increased in the samples (0.1-0.3%). As a result, the viscosity and consistency coefficient of blueberry syrup were increased when compared with the viscosity of blueberry syrup without xanthan gum. Yalçınöz and Erçeleb (2016) compared the concentrations of xanthan gum for use as a thickener in strawberry sauce, sour cherry sauce, and sweet cherry sauce. It was found that with the increase in concentration of xanthan gum (0.15-0.30%), the viscosity of the three fruit sauces was increased. These three fruit sauces have a pH range of 2.83 - 3.75, which is the pH range where xanthan gum was stable as a viscosity agent (pH 2.5-11.0). In this research, the pH of the passion fruit topping sauce was 2.71-2.95, so that pH was also the optimum pH range of xanthan gum that was stable as a viscosity agent. While the viscosity was decreased when the ratio of CMC was increased in the passion fruit topping sauces, Commonly, each hydrocolloid compound had a different efficiency as a thickening agent. It depends on various factors (pH, temperature, or ionic force). In this experiment, passion fruit topping sauce had a pH lower than 3.0. This pH, CMC was depolymerization and precipitation due to changing the anionic polymer to a neutral polymer by losing negative charge at the carboxyl group. When CMC was hydrolyzed in an acidic solution, that loosed the viscosity, precipitated, and changed its ability to function as a thickening agent. While xanthan gum was effective as a stabilizer and had the ability to act as a thickener in the sample (BeMiller, 2019). From the texture analysis, it was found that the firmness, consistency, cohesiveness, and index of visocisity of the passion fruit topping sauces increased when the ratio of CMC was decreased, and xanthan gum was increased. According to research by Sikora *et al.* (2007), using xanthan gum as a substitute for modified starch in strawberry sauce, it was found the concentration of xanthan gum had the effect of increasing the firmness and cohesiveness of the strawberry sauces. This result may be due to the stability of different hydrocolloid compounds as viscosity agents and gelling agents in low pH conditions.

Sensory properties

From the quantitative descriptive analysis, the change of sensory characteristics in the attribute of viscosity in mouthfeel according to the physicochemical properties test. It was found that decreasing the ratio of CMC and increasing xanthan gum had the effect of increasing the viscosity of the

passion fruit topping sauce. The intensity score in terms of smoothness, as perceived by an assessor, decreased when the ratio of xanthan gum increased, and CMC decreased in the passion fruit topping sauce. The increase in intensity may be due to the different rheological properties of hydrocolloids. Commonly, xanthan gum has a weak gel-like. According to previous research by Pereira *et al.* (2007), the study on the effect of xanthan gum at different concentrations (0.25, 0.50, 0.75, and 1.00%) on the rheology properties of Umbo fruit pulp (*Spondias tuberos*) carried out by using an oscillatory rheometer. From viscoelastic behavior, all samples had G' (Storage moduli) greater than G" (Loss moduli). That shows all samples are more like weak gels than viscous liquids. CMC, on the other hand, has a viscous-like texture that feels more like a liquid than a gel.In previous research by Benchabane and Bekkour (2008), they studied the effect of CMC at different concentrations (1, 3, 5 and 7%) on the rheological properties of the solution. They found that at the 1% concentration of CMC was G' less than G" That indicated the sample was more like a viscous liquid than a gel. In this study, passion fruit topping used a concentration of hydrocolloid that was in the similar range as the previous research (maximum concentration of 0.6%). Therefore, when the concentration of xanthan gum was increased and CMC was decreased as a result, the passion fruit topping sauce was more like a gel than a viscous. This gel characteristic is perceived by an assessor and makes them feel that the sample has less smoothness.

In terms of passion fruit flavor, the results showed that decreasing intensity scores when the ratio of CMC was decreased and xanthan gum was increased. This variation could be due to two reasons. The first reason may be due to the formation of a gel structure from hydrophobic compounds that interferes with the rate of diffusion or release of flavor compounds. The next reason may be due to an interaction between hydrocolloid and flavor compounds in the passion fruit topping sauces (Gao *et al.*, 2017). Previous research, Bylaite *et al.* (2005) found the effect of xanthan gum at different concentrations on the release of 20 flavor compounds in a viscous food model. It was found that when the xanthan gum concentration was increased as a result, the release rate of the limonene, ester, and aldehyde groups was reduced. According to research of Yang *et al.* (2016), they studied the influence of xanthan gum and sugar on the flavor release of aqueous solutions. They found xanthan gum had an effect on the release of flavor compounds, especially with flavor compounds that have a high hydrophobic group. Because the flavor compounds' hydrophobic groups could interact with xanthan gums via hydrophobic interaction. Thus, this changes the release of flavor compounds in passion fruit topping because, commonly, passion fruit also contains these flavor compounds in raw material (Janzantti and Monteiro, 2017; Dhawan *et al.*, 2004).

In research, they studied the effect of using different ratios of CMC and xanthan gum on the quality of the physicochemical and sensory properties of the passion fruit topping sauce. The passion fruit topping sauce had a high ratio of xanthan gum and a low ratio of CMC. It had the characteristics of a weak gel-like sauce and intermittent flow when compared to the passion fruit topping sauce ratio of low xanthan gum and high CMC, which was characterized by viscous liquid and more continuous flow sauce. In terms of sensory quality, the ratio of xanthan gum was higher, Sensory intensity in the attribute of viscosity appearance, viscosity in mouthfeel was increased, while in terms of the passion fruit flavor, and smoothness of texture, it tended to decrease when the ratio of xanthan gum was increased. From the preference test, the ratio of CMC and xanthan gum suitable for use as a thickening agent in passion fruit topping sauce was 0.50: 0.50.

Acknowledgements

The authors gratefully acknowledge the financial support provided by Scholarship for talent student to study graduate program in Faculty of Science and Technology, Thammasat University, (Contract No. 21/2561) and Thamasat University Center of Excellence in Food Science and Innovation.

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(Received: 15 August 2021, accepted: 30 October 2021)