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EXTRACTION AND PHYSICOCHEMICAL CHARACTERIZATIONS OF VEGETABLE PECTINS AS A FOOD INGREDIENT IN CREAMY SALAD DRESSING

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The potential of three vegetable pomaces (*Cucumis sativus* Linn., Brassica rapa pekinensis and Brassica oleracea var. capitat) as a source of pectin was evaluated. The extraction time and temperature had significantly influenced on %pectin yield ($p \leq 0.05$). The extracted pectin from *C. sativus* Linn. represented the distinctive physicochemical characteristics and classified as low methoxyl pectin (DM < 50%) that was suitable ingredients in creamy salad dressing. The optimal extraction condition is using 1.0M acetic acid in a ratio of 1:3 (w/v) at 100 °C for 30-60 min. It contained 8.19±0.11% of moisture, 9.79±0.01% of ash, 715.95±2.35 mg of equivalent weight, 49.18±0.35% of anhydrouronic acid (AUA), 2.16±0.02% of methoxyl content and 24.94±0.01% of degree of esterification. The application of *C. sativus* Linn pectin with the strawberry and black pepper creamy salad dressing recipes had the highest overall acceptability score. Therefore, it can be concluded that *C. sativus* Linn. acts as a potential renewable source of pectin for industrial applications.

Keywords: Pectin extraction, Vegetable pomace, Degree of esterification, Physicochemical properties, Creamy salad dressing

INTRODUCTION

Thailand is the agricultural country, an exporter of fruits and vegetables to many countries in the world. The high fraction of discarded materials in the fruits and vegetables processing industries relies on the season, location and post-harvest storage techniques. The effect of fruit and vegetable wastes (pomaces) is one of major concern contributing to global environmental burdens. Therefore, the bioconversion of them is receiving increased attention. The reuse and application of these wastes to increase in value are the alternative way for reducing the environmental problems.

Pectin is one of the polysaccharides (~300-1000 chains of galacturonic acid units) that found in nature, as a cell wall components (Chakraborty and Ray, 2011). It consists the polymerized units of methyl ester of α (1→4)-D-galacturonic (Canteri *et al.*, 2012). It is widely used the food industry as gelling agents (e.g., jams and jellies). According to the FAO (1969), pectin is considered to be a safe additive that can be taken daily without limits (Mohd *et al.*, 2012). Many researches have been reported that it was used as an anti-diarrhea, anti-inflammatory, detoxification, blood glucose and cholesterol lowering (Liu *et al.*, 2006) and hyperlipidemia prevention (Iglesias and Lozano, 2004). Moreover, it was used as nasal and oral drug delivery due to its easily adjustable physical properties and high water contents (Munarin *et al.*, 2012).

The major sources of commercial pectins are derived from citrus peel or apple pomaces that by-products from juice manufacturing. Other sources of pectin include sunflower (Muhamadzadeh *et al.*, 2010), beet and potato pulp (Turquoisa *et al.*, 1999), soy hull (Monsoor, 2005), cocoa husk (Mollea *et*

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al., 2008) and dragon fruit. High Methoxyl (HM) pectins have high degree of methoxylation (DM 50%) and form gels in high sugar concentrations and acid conditions. DM < 50 is called Low Methoxyl (LM) pectins (Fellows, 2009). The extraction methods had effect on the quantitative and qualitative of extracted pectins such as solid-liquid extraction (Shakila Banu *et al.*, 2012), microwave assisted extraction (Zhongdong *et al.*, 2006; and Yoo *et al.*, 2012) and enzyme extraction (Yu and Sun, 2013; Jeong *et al.*, 2014; and Liew *et al.*, 2015). Pectin extraction has multiple-stage under the influence of various factors such as temperature, pH and time. It is well known that the major source of pectin is fruit. However, many vegetables can also be used to pectin source. The unused vegetable debris is very high a large amount in Thailand, especially in the fresh market or the food processing industry. *Cucumis sativus* Linn. (Cucumber), *Brassica rap*a pekinensis (Chinese Cabbage) and *Brassica oleracea* var. capitata. (White Cabbage) are an edible vegetables that used as a cooking ingredient in many menus. There are a lot of waste before the cooking that depended on the location storage and the weather. Therefore, the aims of this research were to study the pectin extraction in the pomace of three vegetables under different conditions and factors mainly concentration of acidic extracting solvent, solute to solvent ratio and extraction time and temperature on the characteristics of pectins and evaluated the potential economic value of extracted pectins for application on creamy salad dressing.

MATERIALS AND METHODS

Sample Collection

Pomaces of *Cucumis sativus* Linn. (Cucumber), *Brassica rapa* pekinensis (Chinese Cabbage) and *Brassica oleracea* var. capitata (White Cabbage) were collected from vegetable market, Nonthaburi province, Thailand.

Preparation of Pomaces

Samples were washed and pressed the remaining pomaces to remove small residues. These samples were cut into small pieces (1.0 cm x 1.0 cm). Then, each raw materials were heated in 95% ethanol in the ratio of 1:1 (w/v) at 80 °C for 10-15 minutes. Next, ethanol solutions were brought out and rinsed three times with distilled water. All pre-treatment materials were kept in polyethylene bags and stored at -20 °C for no longer than 2 weeks before pectin extraction.

Pectin Extraction

The pectin extraction carried out according to Wai's *et al.* method (2010) with some modification. All samples were prepared with different concentration of 0.75, 1.00 and 1.25 M acetic acid in a ratio of 1:2 (w/v). The solutions were then heated 100 °C in the water bath (W350, Memmert, Germany) for 60 min. At the designated time, the pectin solutions were filtered through two layers of cheesecloths and filter papers (Whatman No. 1), respectively. Next, the filtrates were evaporated by using rotary evaporator for 30 min and cooled to 4 °C.

Sedimentation Process

The pectin solutions were precipitated by adding 95% ethanol at a ratio of 1:1.5 (w/v) under continuous stirring and placed at room temperature for 12 hr. The precipitate of pectins (white precipitate) was collected by filtration through filter paper (Whatman No. 1) and then subsequently washed with 95% ethanol (about 20 minutes, 4 times) until a neutral (pH 6.8-7.0). The resultant pectins were dried at 60 °C for 6 hr in an air oven or until constant weight. Dried pectins were crushed through the sieve to powdered form. The % pectin yields were calculated as follows (Leong *et al.*, 2016):

$$\%\ yield = \frac{mass\ of\ dried\ pectin}{mass\ of\ clean\ sample} \times 100$$

Effect of a Ratio of Extracted Raw Material: Acetic acid

The pre-treatment materials were extracted with 1.0 M acetic acid in a ratio of 1:1, 1:2, 1:3, 1:4, 1:5 and 1:6 (w/v), respectively (Azad *et al*., 2014). The extracted pectins were filtered using two layers of cheese cloths and filter paper (Whatman No. 1) and precipitated the same previous method.

Effect of Temperature and Time on Pectin Extraction

The pre-treatment materials were extracted with 1.0 M acetic acid in a ratio of 1:2 (w/v) at different conditions; (i) at 80 °C for 60, 90 and 120 minutes, (ii) at 90 °C for 60, 90 and 120 minutes and (iii) at 100 °C for 60, 90 and 120 minutes, respectively (Kulkarni and Vijayanand, 2010; and Maneerat *et al.*, 2017). The resulting materials (pectins) were filtered through cheese cloths and filter paper (Whatman No. 1) and precipitated the same previous method.

Improvement of Pectin Color

The color of pectins affects the appearance of the final products. The unwanted color of resultant pectins was improved by washing with different condition, including (i) twice 95% ethanol and (ii) twice in 95% ethanol and then in acetone to remove unwanted color (Thongsook *et al.*, 2008).

Analysis and Characterization of Pectin Color

The color measurement of extracted pectins can be determined by using a Hunter Laboratory Color (Quest 45/0; Konica Minolta, Japan) and reported by the CIE system; including three parameters of L* (lightness), a* (green–red component) and b*; (blue–yellow component) (Intelmann *et al.*, 2005).

Moisture and Ash Content

Moisture and ash contents were calculated according to Association of Official Analytical Chemist (AOAC, 2005). 1 g of extracted pectin was transferred into crucible and incubated in an oven (Memmert, Germany) for 24 hr at 55 °C. The crucible was taken out of the oven and cooled in a desiccator. After cooling, the crucible was reweighed again. The residue was weighed the constant weight. Finally, the percentage of moisture was calculated from the loss weight of moisture.

In the ash yield determining, 1 g of pectin in a dried crucible was heated in a muffle furnace (Shimadzu, Japan) at 600 °C for 4 hr. Next, the residue was placed in a desiccator for cooling and weighing until a constant weight. The percentage of total ash was calculated.

Texture Analysis

The preparation of pectin based on Commercial Pectin Preparation Food (CPPF) (150 grade test) (Rolin, 1993). Texture analysis was performed as maximal straight (textural hardness) using a Texture Analyzer (TA-XT2i model, Stable Micro Systems, UK). The experiments are conducted with Texture Profile Analysis (TPA) mode using cylinder probe (diameter 1.0 cm) and speed of 100 mm/min. The gravity force is set to move into the gel which is packed in 80 mm of beaker (a distance of 2.0 cm as center distance of the gel).

Equivalent Weight

Equivalent weight of extracted pectin was determined by titration with 0.1 N NaOH (pH 7.5) using phenol red as an indicator. 0.5 g of pectin was mixed with 100 ml of distilled water and 1 g of sodium chloride (NaCl), respectively. Six drops of phenol red were added in the mixture solution and slowly titrated with 0.1 N NaOH until the solution changes the color (pH = 7.5; pink color) [Titration A]. The equivalent weight was calculated as follows (Nazaruddin *et al.*, 2013).

$$Equivalent\,Weight = \frac{(Weight\ of\ sample \times 1000)}{(ml\ of\ alkali\ \times normality\ of\ alkali)}$$

Methoxyl Content (MeO)

The methoxyl content was determined by adding 25 ml of 0.25 N NaOH to neutral solution. The mixture solutions were allowed to stand for 30 minutes at room temperature. Next, 25 ml of 0.25 N HCl were added and titrated with 0.1 N NaOH to the end point (pink color) [Titration B]. The methoxyl content was calculated as follows.

$$\%\,MeO = \frac{[meq\ titration\ B \times 31 \times 100]}{[weight\ of\ sample\ (mg)]}$$

where 31 is the molecular weight of methoxyl.

Anhydrouronic Acid (AUA)

Anhydrouronic acid content is an important for analyzing the purity and degree of esterification and evaluation of physical properties. AUA (M_w = 176) was calculated after knowing the equivalent weight and methoxyl content of pectins by following equation.

$$\%AUA = \frac{(176 \times 100)}{z}$$

where

$$Z = \frac{[weight\ of\ sample\ (mg)]}{[meq\ titration\ A + meq\ titration\ B]}$$

Degree of Esterification (DE)

Degree of esterification of extracted pectin was calculated as follows;

$$\%DE = [(176 \times \%methoxyl\ content)/(31 \times AUA\%)]$$

Development of Salad Dressing Creamy Product and Sensory Evaluation

The resultant pectins were evaluated smell by in 5-point Hedonic Scale. Then, the suitable pectin from vegetable samples was used as an ingredient in salad dressing creamy product of total 6 recipes; including black pepper, wasabi, yogurt, yogurt-black pepper, strawberry and mustard. All products were evaluated the organoleptic properties, including the color, appearance, flavor, odor, texture, and overall acceptability by the 9-point Hedonic Scale (9 = like extremely to 1 = dislike extremely; 50 persons) (Basu and Shivare, 2010).

Statistical Analysis

All of the data were done in triplicate (±SD) and analyzed using Variance (ANOVA). T-test was performed to analyze the significant differences between treatments ($p \leq 0.05$).

RESULTS AND DISCUSSION

% Pectin Yield

The pomaces of three vegetables (*Cucumis sativus* Linn., *Brassica rapa* pekinensis and *Brassica oleracea* var. capitata) were pretreated with absolute ethanol to inhibit enzyme activities, pesticides, pathogens and other impurities before pectin extraction. The influence of acid concentration (acetic acid) on the % yield of pectin was given in Table 1. The result showed that the 0.75 M acetic acid was the optimum condition for gelatin extraction of *C. sativus* Linn. and *B. oleracea* var. capitata that showed the % yield pectin of 6.11±0.01 and 6.17±0.04%, respectively. At 1.0 M acetic acid was suitable condition of extracting pectin from *Brassica rapa* pekinensis which was not significantly different among plants ($p>0.05$).

Table 1: Effect of Acid Concentration on % Pectin Yield of Vegetable Pomaces

Source of Raw Materials	Pectin Yield (% ±SD)		
	0.75 M Acetic Acid	1.00 M Acetic Acid	1.25 M Acetic Acid
C. sativus Linn.	6.11 ± 0.01^{aA}	6.06 ± 0.01^{aA}	6.07 ± 0.02^{aA}
B. rapa pekinensis	6.03 ± 0.01^{aA}	6.13 ± 0.05^{aA}	6.10 ± 0.02^{aA}
B. oleracea var. capitata.	6.17 ± 0.04^{aA}	6.13 ± 0.01^{aA}	6.13 ± 0.01^{aA}

Note: Mean±SD (triplicate deteminations); Values with different letters in the same row or column are significantly different ($p\leq0.05$).

The effect of solute: solvent ratio on pectin yields was analyzed. At the 1:3 ratio of extraction was significantly resulted in the maximum yield of pectin in *C. sativus* Linn. and *B. rapa* pekinensis ($p\leq0.05$) while, *B. oleracea* var. capitata was at the 1:5 ratio (Table 2). However, the time duration of heat-treated samples had influenced towards pectin yield. Heat treatment at 100 °C within 30 min showed significant high yield of pectin. At heat treatment prolong to 90 min, an increase in approximately 2% pectin yield was displayed in samples at 1.0 M acetic acid ratio of 1:2 (w/v) (Table 3).

Extended extraction time did not directly influence on pectin yield from all vegetable pomaces at 80-100 °C. But Sangkharak *et al.* (2011) reported that long extraction times (>180 min) affected a decrease in the yield of pectin. Based on the % pectin yield, acid concentration, heat treatment and time period, at 1.0 N acetic acid with the extraction time of 90 min at 100 °C is the optimum condition for the highest extraction yields of all samples. These results were consistent with previous study in *B. oleracea* var. capitata but it was at 100 °C for 90 minutes in the study of Sukkasem and Anukulwattana (2016). The pectin yield increased with rising extraction temperatures reached the highest value at 100 °C due to increase of the diffusion coefficient (Quoc *et al.*,

Table 2: Effect of Solute-Solvent Ratio on % Pectin Yield of Vegetable Pomaces

Source of Raw Materials	Gelatin Yield (% ±SD)		
	C. sativus Linn.	*B. rapa* pekinensis	*B. oleracea* var. capitata.
1:01	6.07 ± 0.03^{aC}	6.03 ± 0.01^{aC}	6.03 ± 0.01^{aB}
1:02	6.08 ± 0.07^{C}	6.17 ± 0.04^{aBC}	6.13 ± 0.05^{aB}
1:03	8.23 ± 0.01^{aA}	8.18 ± 0.03^{aA}	6.16 ± 0.02^{bB}
1:04	7.23 ± 0.03^{aB}	7.14 ± 0.02^{abB}	6.19 ± 0.01^{bB}
1:05	7.20 ± 0.04^{aB}	7.13 ± 0.04^{aB}	7.22 ± 0.03^{aA}
1:06	7.23 ± 0.03^{aB}	7.15 ± 0.05^{aB}	7.22 ± 0.02^{aA}

Note: Mean±SD (triplicate deteminations); Values with different letters in the same row (^{ABC}) or column (^{ab}) are significantly different ($p\leq0.05$).

Table 3: Effect of Temperature and Time on % Pectin Yield of Vegetable Pomaces

Source of Raw Materials	Temperature (°C)	Pectin Yield (% ±SD)[a]		
		30 min	60 min	90 min
C. sativus Linn. (Cucumber)	80	6.06 ± 0.02^{aB}	6.07 ± 0.02^{aB}	6.09 ± 0.01^{aB}
	90	6.06 ± 0.01^{aB}	6.10 ± 0.02^{aB}	6.16 ± 0.05^{aB}
	100	8.11 ± 0.02^{aA}	8.15 ± 0.03^{aA}	8.23 ± 0.03^{aA}
B. rapa pekinensis (Chinese Cabbage)	80	6.04 ± 0.03^{aB}	6.05 ± 0.01^{aB}	6.08 ± 0.01^{aB}
	90	6.04 ± 0.02^{aB}	6.07 ± 0.02^{aB}	6.08 ± 0.03^{aB}
	100	8.10 ± 0.07^{aA}	8.12 ± 0.03^{aA}	8.18 ± 0.02^{aA}
B. oleracea var. capitata. (White Cabbage)	80	6.15 ± 0.05^{aB}	6.19 ± 0.01^{aB}	6.20 ± 0.02^{aB}
	90	6.16 ± 0.03^{aB}	6.21 ± 0.01^{aB}	6.21 ± 0.03^{aB}
	100	8.17 ± 0.04^{aA}	8.22 ± 0.03^{aA}	8.28 ± 0.07^{aA}

Note: Mean±SD (triplicate deteminations); Values with different letters in the same row or column are significantly different ($p\leq0.05$).

2015). However, extreme temperatures (>100 °C) may result in loss of pectin contents.

Based on effects of various factors, the results indicated that extraction temperatures had influenced on pectin yield. But acid concentrations, extraction times, solute: solvent ratios had no effect ($p>0.05$). These findings were inconsistent with previous study by Zhang and Mu (2011) who reported that extraction times/temperatures and solvent ratios significantly affected the % yield of pectin.

Physicochemical characterizations of all pectin (three vegetable pomaces), including their moisture content, ash content and color were determined. The results were summarized in Table 4. The pectin yields of three vegetables were approximately 7%. Based on previous results, the % pectin yields of samples in this study had higher than that of *Cucumis sativus* Linn. (0.2%) (Sudheesh and Vijayalakshmi, 2007) and *Brassica rapa* pekinensis (0.05%). But they had lower than % pectin yield of *B. oleracea* var. capitata (15.80%) from previous study of Sukkasem and Anukulwattana (2016). The pectin extract of *C. sativus* Linn. contained 8.19±0.11% moisture and 9.79±0.01% ash and that of *B. oleracea* var. capitata and *B. rapa* pekinensis contained 9.18±0.12-9.40±0.16% moisture and 15.60±0.01-20.04±0.01% ash. The pectin of *B. rapa* pekinensis pomace was rich in moisture and ash contents which had higher than ash content (3.8%) in study of Sangkharak *et al.* (2011). However, pectin powder should be had low moisture content because it will safe storage and prevent pectinase activity as well as microorganism growth (Ismail *et al.*, 2012).

Table 4: Physicochemical Propertied and Characteristics of Extracted Pectins

Properties of Gelatin	*Cucumis sativus* Linn.		*Brassica rapa* pekinensis		*Brassica oleracea* var. capitata	
Yield of pectin; %	7.11±0.02[a]		7.13±0.01[a]		7.13±0.05[a]	
Moisture content; %	8.19±0.11[b]		9.18±0.12[a]		9.40±0.16[a]	
Ash content; %	9.79±0.01[c]		20.04±0.01[a]		15.60±0.01[b]	
Color of Pectin	**E**	**E+A**	**E**	**E+A**	**E**	**E+A**
	Yellow	**Light Yellow**	**Yellow**	**White**	**Brown**	**Light Brown**
Texture analysis; N	0.08±0.003[a]		0.07±0.001[a]		0.07±0.003[a]	
Equivalent Weight; mg	715.95±2.35[a]		555.35±0.29[c]		636.76±0.71[b]	
Methoxyl Content; %	2.16±0.02[a]		1.81±0.04[b]		2.28±0.08[a]	
AUA; %	49.18±0.35[a]		40.29±0.25[c]		44.60±0.17[b]	
DE; %	24.94±0.01[b]		25.51±0.01[b]		31.61±0.01[a]	
Sensory scores (odor)	3.98±0.53[a]		3.06±0.71[ab]		2.76±0.62[b]	

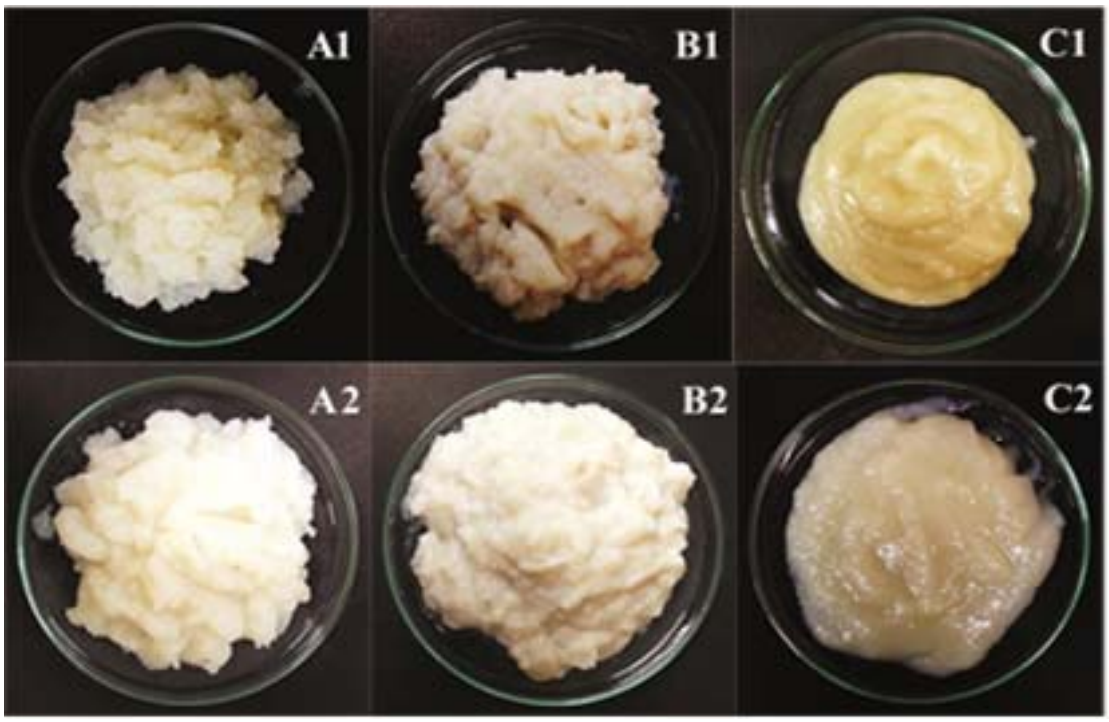
Note: Mean±SD (triplicate deteminations); Values with different letters in the same row or column are significantly different ($p\leq0.05$).; E = Ethanol; A = Acetone.

Pectin of *C. sativus* Linn. had the lowest moisture and ash contents when comparing with all of the pectin extracts. *Brassicaceae* family (*B. rapa* pekinensis and *B. oleracea* var. capitata) pectins represented the very high the % ash content due to large amount of inorganic impurities (Ermias and Teshome, 2016). Both plants have high levels of minerals that can be contaminated during pectin extraction. Impurity of their pectins might be influence on the smell and color of the extracted pectin. The low ash content (below 10%) indicates the pectin purity and good gel-forming (Yapo and Koffi, 2006). Therefore, *C. sativus* Linn. pectin was rather pure. It might have positive gel-forming ability.

The color of extracted pectin in term of L*, a*, and b* value was determined by colorimeter (Table 4). It is an important factor for the product appearance. The color of extracted pectin from three vegetable pomaces was revealed better color after washing with ethanol and acetone when compared with washing with only ethanol (Figure 1). Acetone solution can be removed the unwanted pectin color. The colors of *C. sativus* Linn., *B. rapa* pekinensis and *B. oleracea* var. capitata pectins were light yellow, white and light brown.

According to equivalent weight, the results showed that the extracted pectin of *C. sativus* Linn. represented significantly higher equivalent weight (715.95±2.35 mg) than that of both *Brassicaceae* family (555.35±0.29-636.76±0.71 mg) (Table 4). For *B. rapa* pekinensis pectin, at 1M acetic acid as an extracting agent had the equivalent weight of 636.76±0.71 mg. This value was lower than this reported by Sukkasem and Anukulwattana (2016) for using 1 N hydrochloric acid and (636.76±0.71 mg) higher than for using 1 N nitric acid (432.03±0.43 mg). The difference values of

Figure 1: Pectin Extracted from *Cucumis sativus* Linn. (A), *Brassica rapa* pekinensis (B) and *Brassica oleracea* var. capitata (C) in Washing with Ethanol (1) and Ethanol–Acetone (2)



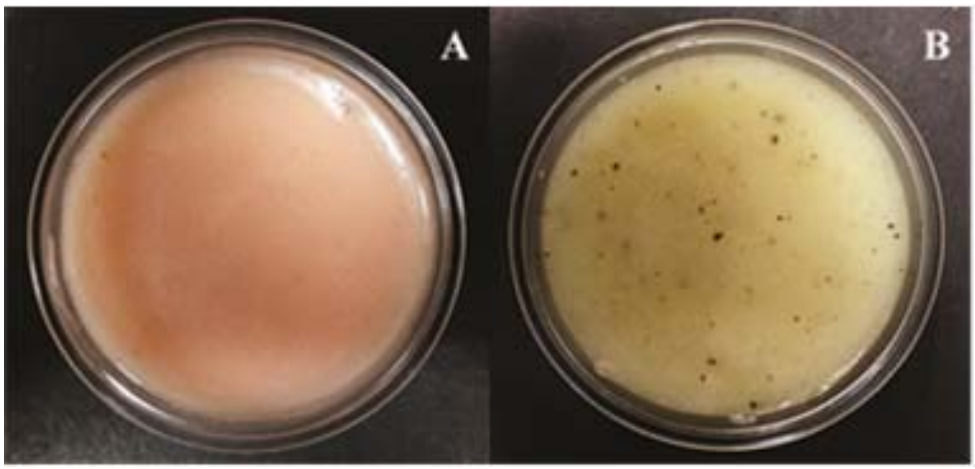
equivalent weight might be dependent on the amount of free acid (Ramli and Asmawati, 2011). Equivalent weight was also used for calculating of % AUA and % DE contents.

Total anhydrouronic acid content (AUA) plays an indicator of purity of extracted pectin. The minimum value of AUA for commercial pectins should not be less than 65% by Food Chemical Codex (1996) mention. In this study, pectin extracted from *C. sativus* Linn., *B. rapa* pekinensis and *B. oleracea* var. capitata showed low values of AUA (49.18±0.35, 40.29±0.25 and 44.60±0.17%, respectively) due to presence of proteins, starches, and sugars in the precipitated pectins (Castillo-Israel *et al.*, 2015). These values of *Brassicaceae* family (40.29±0.25-44.60±0.17%) were comparable to extracted pectin of *Roselle calyx* pectin (42.24%; ammonium oxalate).

The Degree of Esterification (DE) and methoxyl content of three vegetable pomaces pectins ranged from 24.94±0.01-31.61±0.01 and 1.18±0.04-2.28±0.08%, respectively (Table 4). These values of degree of esterification (DE) were comparable to lemon outer skin (24%), red orange waste (25%) and red orange peel (30%) pectin (Rosaria *et al.*, 2017). These findings indicated that all extracted pectins were classified into low methoxyl pectins because their % DE is lower than 50%. However, Sukkasem and Anukulwattana (2016) found high-methoxyl pectin (DE = 51.89%) from *B. oleracea* var. capitata.

According to smell evaluation of extracted pectin (5-point hedonic scale), the *Cucumis sativus* Linn. pectin is a suitable ingredients for applying in salad dressing creamy recipe due to the highest satisfaction in odor (sensory score of 3.98±0.53; like very much). It also had unique physicochemical properties when comparing with extracted pectin from *B. rapa* pekinensis and *B. oleracea* var. capitata. Normally, the salad dressing creamy contains high amount of fat. Extracted pectin can be used to replace the fat in the salad dressing creamy in this study. The sensory profiles of salad dressing creamy recipes were evaluated in terms of color, appearance, flavor, odor, texture and overall acceptability by 9-point hedonic scales. Almost all sensory evaluation scores for strawberry and black pepper salad dressing prepared with *C. sativus* Linn. pectin were slightly higher other salad dressing creamy recipes (Figure 2). The

Figure 2: Development of Strawberry Salad Dressing Creamy (A) and Black Pepper Salad Dressing Creamy (B) with *C. sativus* Linn. Pectin



overall acceptability scores of strawberry and black pepper salad dressing were 8.24 (like very much) and 8.00 (like very much), respectively. All salad dressing recipes using commercial pectin had customer satisfaction score of 7.96 (like very much).

CONCLUSION

Cucumis sativus Linn., *Brassica rapa* pekinensis and *Brassica oleracea* var. capitat can be an alternative source of pectins, especially *C. sativus* Linn. (Cucumber). These findings indicated that the acid-extracted pectin of *C. sativus* Linn. was rather in purity and good gel formation ability (<10 of % ash) which was the appropriate physicochemical properties and can potentially be used in food products such as salad dressing creamy. In the *Brassicaceae* family, there was a need to improve the qualification of extracted pectin before application in food industry.

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