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PHYSICOCHEMICAL PROPERTIES AND SENSORY EVALUATION OF JELLY CANDY MADE FROM DIFFERENT RATIO OF κ-CARRAGEENAN AND KONJAC

Sifat Fisikokimia dan Evaluasi Sensori Permen Jeli yang Terbuat dari κ-karaginan dan Konjak dengan Rasio yang Berbeda

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ABSTRACT

A study on quality of jelly candy formulated from κ-carrageenan and konjac (jelly powder), has been conducted. The objective of this study was to determine the best ratio of κ-carrageenan and konjac in the formulation of jelly candy. The ratio of κ-carrageenan and konjac was varied from 40:25; 35:30; 30:35; to 25:40. The quality parameters observed on jelly candy produced were gel strength, elasticity, stickiness, water activity (a_w), and sensory test. Results showed that the best ratio of κ-carrageenan to konjac was 40:25 (formula A) which produced candy with physicochemical quality closed to that of commercial one with hardness of 470.7 g, elasticity of 4.5 mm, stickiness of 36.15 g, and a_w of 0.5. While the results of the sensory test showed that the difference ratio of κ-carrageenan and konjac had no significant effect on the product. Based on that result, the best formulation in production of jelly candy was formula A.

Keywords: jelly candy, κ-carrageenan, konjac, jelly powder

ABSTRAK

Telah dilakukan penelitian tentang mutu permen jeli yang di buat dari jeli bubuk yang diformulasi dari κ-karaginan dan konjak. Tujuan dari penelitian ini adalah untuk mendapatkan perbandingan optimum κ-karaginan dan konjak dalam formulasi permen jelly. Perlakuan pada penelitian ini adalah perbandingan κ-karaginan dan konjak yang di variasi 40:25; 35:30; 30:35; dan 25:40. Parameter yang diamati pada permen jelly adalah kekerasan, elastisitas, kelengketan, a_w dan uji sensori. Formula A dengan perbandingan κ-karaginan : konjak 40:25 menghasilkan kualitas permen jeli yang mendekati kualitas permen jeli komersial. Karakteristik yang dihasilkan dengan perbandingan tersebut adalah kekerasan 470,7 g, elastisitas 4,5 mm, kelengketan 36,15 g, dan a_w 0.50. Hasil uji sensori menunjukkan bahwa perbedaan perbandingan κ-karaginan dengan konjak tidak memberi pengaruh nyata pada produk. Berdasarkan hasil tersebut, formula terbaik dalam pembuatan jelly candy yang direkomendasikan ialah formula A.

Kata Kunci: permen jeli, κ-karaginan, konjak, jeli bubuk

1. Introduction

Candy is one of favourite foods among people from a wide range of age. Candy typically varies in types, shapes, taste and colors (Oktavianti, 2003). According to National Standard Agency (*Badan Standarisasi Nasional* /BSN) (2008), candy is defined as a type of solid food from sugar or a mixture of sugar with other sweetener as the main ingredient, with or without addition of food additives. Habilla et al (2011) stated that chewy candies made with different gelling agents and sweeteners offer certain/specific texture characteristics and eating properties. Jellies, caramels, nougats and taffies are the most common chewy candies beside chewing gums.

Jelly candy recipes are mostly developed by experienced food technologists and chemists. By blending together different ingredients, they can control the various characteristics of jelly candy, such as texture, taste, and appearance. The primary ingredients include water, gelatin, sweeteners, flavors, and colors. The main ingredient responsible for the candy's unique and gummy characteristics is gelatin (Traxler, 1993). However, utilization of gelatin on jelly candy leads to the increase of cost production. This problem can be overcome by blending gelatin with hydrocolloids, which are believed to be able to improve candy's texture, enhance moisture retention, and overall keeping quality (Habilla et al., 2011).

Hydrocolloids which are considered to have an ability to improve food texture are κ-carrageenan and konjac. Κ-carrageenan is mainly used in food application as a texture enhancer. The primary function of κ-carrageenan depends largely on its ability to form cold-setting reversible gels. The gelation process of κ-carrageenan has been extensively studied with respect to the conformational transition of κ-carrageenan molecules (Piculell, 1995). Meanwhile, konjac gum is a hydrocolloid gum derived from the tubers of *Araceae amorphophallus*, which comprises 60-70% konjac glucomannan. It has been recognized as GRAS (generally recognized as safe) by a consensus of scientific opinion 1994 (Khanna & Tester, 2006). It is widely utilized in the areas of food industry (Al Ghazzewi et al., 2007). Konjac is also regarded as non caloric food and source of indigestible high quality dietary fiber when it is in its traditional form (Pan et al., 2011). Due to its high viscosity, konjac is generally added to other hydrocolloids in order to increase the viscosity of blended system and improve food quality (Yaseen et al., 2005).

The blending κ-carrageenan and konjac has been extensively studied by many researchers. Sinurat, Murdinah & Utomo (2006) revealed that mixture of κ-carrageenan and konjac resulted in gel strength and viscosity higher than other hydrocolloid mixture, therefore its formulation is suitable to produce jelly candy. Subaryono & Utomo (2006) have observed the use of κ-carrageenan-konjac in jelly candy production showing that the optimum concentration of κ-carrageenan-konjac used in jelly candy processing was 1.5% with ratio 2:1. However, in almost the same case, Sinurat et al., 2010 studied the characteristic of jelly candy made of formulated jelly powder. The result showed that higher concentration of jelly powder tended to the increase of jelly candy's gel strength, stickiness, and elasticity. The highest organoleptic score for taste, texture, elasticity, transparency and acceptance was achieved by jelly powder at concentration of 4.5%.

Based on the above analysis, there has been lack of study conducted to investigate the optimization of κ-carrageenan and konjac proportion in jelly candy production. Therefore, this work was to determine the effect of different ratio κ-carrageenan-konjac on physicochemical properties and sensory acceptability of jelly candy.

2. Material and Methods

2.1. Materials

The main material used in this experiment was κ-carrageenan extracted from *Eucheuma cottonii,* using extraction method developed by Hakim et al. (2011), the characteristic of κ-carrageenan used was shown in Table 1.

Other material used in jelly candy processing was commercial konjac powder having specification as follows: particle size 120 mesh, glucomannan content 95% DB (dry bases), viscosity 30.000 mPa.s, moisture 10%, ash 3.0%, Pb 1 mg/kg, As 2.0 mg/kg, SO_2 of 100 ppm 100 pH of 5.0-7.0, Total Plate Count (TPC) value 3000 CFU/g, mold and yeast number 15 CFU/g. In addition, other supporting inggredients used in this experiment were dextrose

Table 1. Properties of κ-carrageenan

Parameters	Value
Gel strength (g/cm^2)	965.40
Elasticity (mm)	9.40
Viscosity (cPs)	49.00
a_w	0.33
Whiteness	62.40
Water content (%)	10.0
Total ash (%)	8.2
Acid insoluble ash (%)	0.02
Sulphate content (%)	17
Syneresis (%)	0.05

and KCl (food grade). The equipment used for physical test were hotplate, analytical balance, viscometer (Brookfield), TA-XT Plus texture-analyzer, a_w sprint (Novasina, model TH 500).

2.2. Methods of Jelly Candy Processing

In this research, the proportions of κ-carrageenan to konjac used in jelly powder was varied: 40:25; 35:30; 30:35; 25:40 based on modified method of Sinurat et al., 2010. The formulas of jelly powder were then applied to the jelly candy processing. The detail formulation of jelly powder is presented in Table 2.

These formulas were then blended with other ingredients (Table 3) to produce jelly candy. The procedure of jelly candy processing is described as follows: water, high fructose syrup (HFS), and sugar were poured into a blender and blended for 1–2 minutes or until small particles of sugar was obtained. The homogenous jelly powder was poured into the mixture and heated to approximately 80°C for 5 minutes. Sodium benzoate, potassium citrate, and flavour were added and molded immediately in a molder (dimension of 200mm x 140mm x 60 mm). The mold was then covered and wrapped with aluminum foils and frozen overnight. The jelly was then cut into dimension of 30 mm x 18 mm x 12.5 mm and then dried in an oven at 50-60°C for 48 hours. Finally, the dried jelly candy was coated with icing sugar.

2.3. Parameters Analysis

Analysis of physical properties was conducted for both jelly powder and jelly candy. The jelly powder was analyzed for its gel strength, elasticity, and viscosity while jelly candy was analyzed for its hardness, elasticity, and stickiness using *TA-XT plus texture analyzer.*

Jelly candy which dimension approximately of 2.5 cm x 1.5 cm x 1 cm was measured for its hardness, elasticity, and stickiness using TA-XT Plus texture-analyzer using probe p/2 cyl stainless (diameter of 2 mm) with distance and velocity of 5 mm and 2 mm/s, respectively (Tuazon, 1996).

Gel strength which is defined as force needed to break gel surface in certain time divided by distance was measured by mixing 3 g of sample with 197 ml of distilled water and 0.6 g of KCl in a beaker glass in order to make 1.5% sample solution with 0.3% of KCl. The solution was heated on hot plate with continuous stirring until the temperature reached 80°C. After 80°C was reached, the solution weight was adjusted to initial weight in order to replace evaporated water, thus the sample concentration was conserved. Afterwards, the solution was re-stirred to homogenize. The hot solution was then poured into glass shaped plastic mold whose diameter was approximately 6.5 cm. The mold was immediately closed and left to cool down to 10°C for

Table 2. Formulations of Jelly Powder using different ratio of κ-Carrageenan to konjac (%)

Ingredients	Control (without konjac)	Formula A	Formula B	Formula C	Formula D
k -Carrageenan	65	40	35	30	25
Konjac	0	25	30	35	40
KCl	8	8	8	8	8
Dextrose	27	27	27	27	27
Total	100	100	100	100	100

Table 3. Formulation of Jelly Candy

Ingredient	Concentration (%)
Jelly Powder	4.5
High Fructose Syrup	47.0
Sugar	9.7
Potassium citrate	0.2
Flavor	1.0
Sodium benzoate	0.1
Water	37.5

14 – 24 hours. Finally, the gel strength and elasticity was measured by TA-XT plus Texture Analyzer using probe number P/0.5R (diameter 126.26 mm, material delrin) with test speed 2 mm/s and distance 25 mm. The force should be given to the center of the gel sample. The gel strength was calculated by dividing force given with area of the probe (Marine Colloids, 1978).

The viscosity analysis was conducted by weighing 2.25 g of sample and added into mixture of 147.75 ml of distilled water in a beaker glass to make 1.5% sample solution. The solution was heated on hot plate with continuous stirring to 80°C. The solution weight was adjusted to initial weight in order to replace evaporated water. The solution was re-stirred to homogenize. The viscosity of the solution was then measured using Brookfield viscometer (FMC Corp, 1977).

The determination of best formulation of jelly powder was based on the panelists acceptance to the product as an indicator of market acceptance to the product. Sensori test was also conducted to determine which formula was prefered by panelists. The test was performed by 15 semi-trained panelists. Method used was scoring test for attributes using 1 to 5 scale and overall hedonic test using 1 to 5 scale.

The experiment was conducted in three replicates. Data analysis for physical and chemical tests were done using SPSS program with one way analysis of variance (one–way ANOVA) with confidence level of 95%. Sensory test was conducted using univariate analysis of variance with confidence level of 95%, and followed by Duncan test using post hoc analysis.

3. Results and Discussion

3.1. Jelly Powder Properties

The physicochemical properties of jelly powder were tabulated in Table 4.

It can be seen from the table that the addition of konjac in these formulas increased elasticity and viscosity but the decreased gel strength . Total ash, acid insoluble ash and syneresis were decreased as well . It seems that κ-carrageenan and konjac worked synergistically to improve properties of jelly powder. Brenner et al (2013); Jiao He et al (2012) reported that mixed polysaccharide gels containing konjac, glucomannan and κ-carrageenan were able to increase firmness and reinforce the elasticity of the gels. The addition of konjac caused an effective reduction of syneresis and reduced the gel hardness in rice starch gels which is subjected to repeated freeze–thaw cycles (Tatirat et al., 2011). Mixing of konjac and κ-carrageenan is widely applied in the food industry; however, their intermolecular interaction mechanisms have not been fully elucidated (Liang et al, 2011).

3.2. Jelly Candy Properties

3.2.1. Hardness

Hardness of jelly candy is shown in Figure 1. Based on statistical analysis with confidence level of 95%, the difference in jelly powder formulation influenced the hardness of jelly candy significantly. The highest value of hardness (739.39 g), was obtained

Table 4. Physical and chemical properties of jelly powder

No	Parameters	Control (without konjac)	Formula A	Formula B	Formula C	Formula D	Jelly powder Ellya et al., 2010
1.	Gel strength (g/cm^2)	477	2340	2267	1751	1636	1604
2.	Elasticity (mm)	7.4	17.4	18.8	20	24.7	-
3.	Viscosity (cPs)	19.0	502.5	547.5	635.5	1270	525
4.	Total ash (%)	26.4	19.4	18.7	16.82	11.54	-
5.	Acid insoluble ash (%)	0.3	0.2	0.2	0.13	0.14	-
6.	Syneresis (%)	7.6	5.8	4.7	3.49	1.78	-

Note: Control: carrageenan 65%, konjac 0%; Formula A: carrageenan 40%, konjac 25%;
Formula B: carrageenan 35%, konjac 30%; Formula C: carrageenan 30%, konjac 35%;
Formula D: carrageenan 25%, konjac 40%; Jelly powder: characteristic previous research.

from Control. On the contrary, the lowest value (388.26 g), was resulted from Formula B.

Duncan test showed that hardness of commercial product (498.8 g) was significantly different from Formula B, Formula C, and Control. But it was insignificantly different from Formula A (470.6 g) and Formula D (537.3 g).

Hardness values in this study was higher than those resulted from the experiment of Subaryono & Utomo (2006) with the hardness of 131.5 g. Sinurat et al., 2010, showed that best hardness on jelly candy was produced with the addition of 4.5% jelly powder. However the value of hardness (246.5 g) resulted from those researches was still lower than this research result.

Hardness is caused by intramolecular bridges in κ-carrageenan which is formed in the presence of K^+ from KCl. The bridge was formed first by ionic bond between K^+ and the sulfate group of D-galactose residue and second by electrostatic bond between the K^+ and the anhydro-O-3,6 ring of the other D-galactose (Sen & Erboz, 2010).

Other investigation (Habilla et al., 2011) showed that the hardness of fresh jelly candy sample tested were found to decrease with the addition of konjac, but it progressively increased as the samples were stored for 8 weeks at 30°C.

3.2.2. Elasticity

The elasticity values of jelly candy were shown in Figure 2. The most elastic product was control with elasticity value of 5.0±0.00 mm, yet it was still less elastic than commercial product which had elasticity value of 5.85±1.21 mm. The least elastic product was Formula C with elasticity of 4.07±0.11 mm. The result showed that jelly powder formulation influenced the elasticity of jelly candy. Based on Duncan test, Formula C and Formula D were not significantly different from Formula B, and Formula A, but significantly different from Control and commercial product. Formula B, Formula A, and Control were not significantly different. The commercial product were significantly different compared to all jelly candy formulation produced in this experiment. The formulas with the elasticity closest to commercial product were Formula A, B and Control.

These formulas (A, B, and control) have carrageenan concentration higher than formula C and D thus bringing higher elasticity value. It is likely that the commercial jelly candy was using formula with carrageenan concentration higher than other polysaccharides. The presence of konjac in these formulas were not improved the elasticity of jelly candies. Subaryono & Utomo (2006) reported that concentration of carrageenan-konjac 1.5% was still

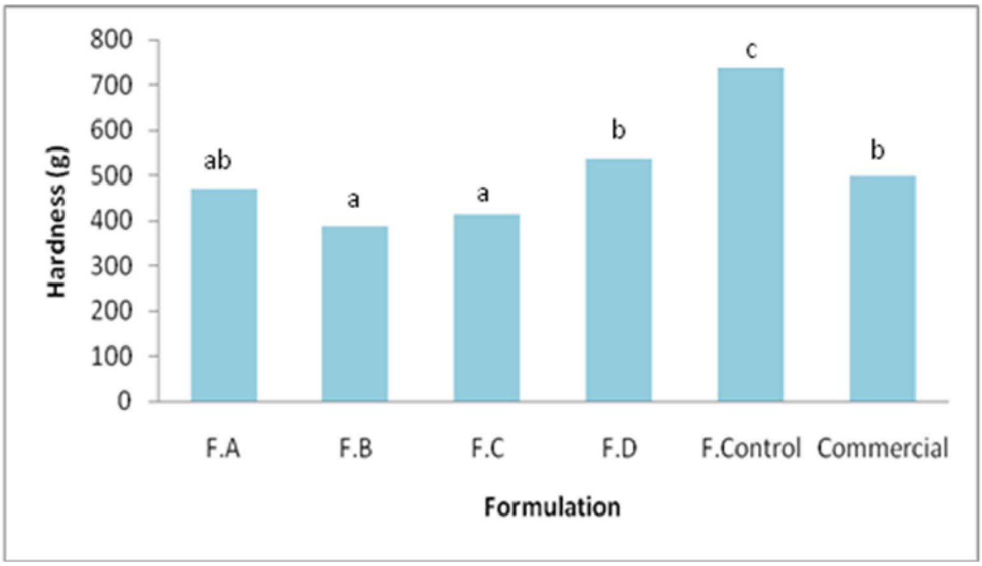

Figure 1. Hardness of jelly candy.

Notes: F.A/Formula A: carrageenan 40%, konjac 25%; F.B/Formula B: carrageenan 35%, konjac 30%; F.C/Formula C: carrageenan 30%, konjac 35%; F.D/Formula D: carrageenan 25%, konjac 40%; Control/Control: carrageenan 65%, konjac 0%; Commercial: commercial product; Different letters superscripted on the results indicate significant difference (P>0.05) between each parameter tested

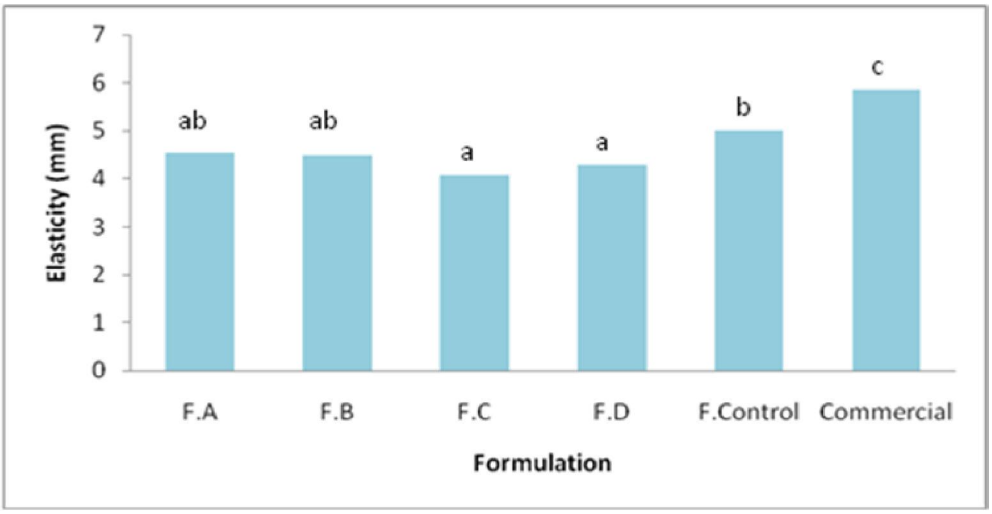

Figure 2. Elasticity of jelly candy

Notes: F.A/Formula A: carrageenan 40%, konjac 25%; F.B/Formula B: carrageenan 35%, konjac 30%; F.C/Formula C: carrageenan 30%, konjac 35%; F.D/Formula D: carrageenan 25%, konjac 40%; Control/Control: carrageenan 65%, konjac 0%; Commercial: commercial product; Different letters superscripted on the results indicate significant difference (P>0.05) between each parameter tested.

not equal yet to gelatin in producing elasticity of jelly candy.

3.2.3. Stickiness

The stickiness values of each jelly candy are shown in Figure 3. Statistic analysis resulted that different formulation of jelly powder affected the stickiness of the product. The lowest stickiness value was gained from Control which was 22.85 g while the highest value was Formula C with stickiness value of 54.92 g. The closest value to the commercial (30.05 g) in terms of stickiness was Formula A (36.15 g).

Konjac in this work rendered the stickiness of the jelly candy to increase. Properties konjac, i.e ability to hold water in gel mechanism is considered to be its causal factor. Habilla et al (2011) showed that the addition of konjac enhanced water holding capacity of the acid-tinned starch jelly candy.

3.2.4. Water activity

The results of water activity are plotted in Figure 4. Statistic test indicates that formulation of jelly candy influenced to water activity. Different formulation resulted in significant difference of water activity. The lowest water activity was resulted from Control with only 0.45. The highest one was held by Formula D with a value of 0.50.

Water activitys (a_w)defined as free, or available water in system. Water activity affects the shelf life, safety, texture, flavor, and smell of foods. It may be the most important factor in controlling spoilage. Most bacteria do not grow at water activities below 0.91, and most molds cease to grow at water activities below 0.80. There are requirements in defining water activity, which are: pure water (a_w = 1.0) which is the standard state; the system is in equilibrium, and the temperature is stated (Anon., 2011). Winarno (1980) claimed that a_w minimum for bacteria and mold to grow is 0.7. Therefore water activity values of the products in this experiment was under the requirements and fulfill the safety requirement.

Water activity of jelly candy tended to decreased with the addition of konjac. It might be caused by the ability of konjac to prevent moisture absorption and retention. Previous studies have described the structure and super-absorbent properties of the derivative of konjac glucomannan which had incorporated hydrophilic groups with a network structure by grafting with sodium acrylate (Liu et al, 2004).

3.2.5. Sensory test

Sensory evaluation is a scientific method used to measure and analyze responses to products as perceived through the senses of sight, smell, touch, taste and hearing. At this test, the best formula was shown by the highest sensory value.

The attributes in the scoring test were texture, elasticity, transparency, aroma, and taste. The sensory evaluation results are tabulated in Table 5.

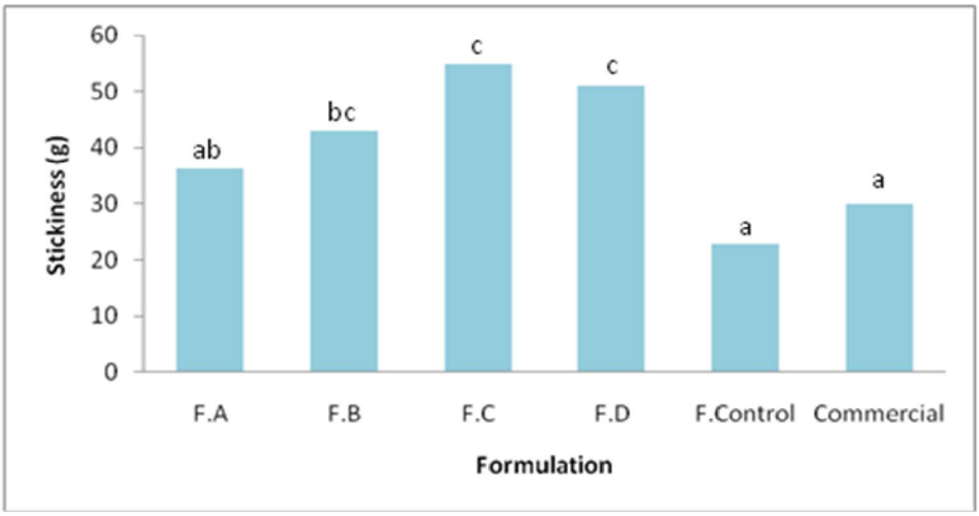

Figure 3. Stickiness of jelly candy.

Notes: F.A/Formula A: carrageenan 40%, konjac 25%; F.B/Formula B: carrageenan 35%, konjac 30%; F.C/Formula C: carrageenan 30%, konjac 35%; F.D/Formula D: carrageenan 25%, konjac 40%; Control/Control: carrageenan 65%, konjac 0%; Commercial: commercial product; Different letters superscripted on the results indicate significant difference (P>0.05) between each parameter tested.

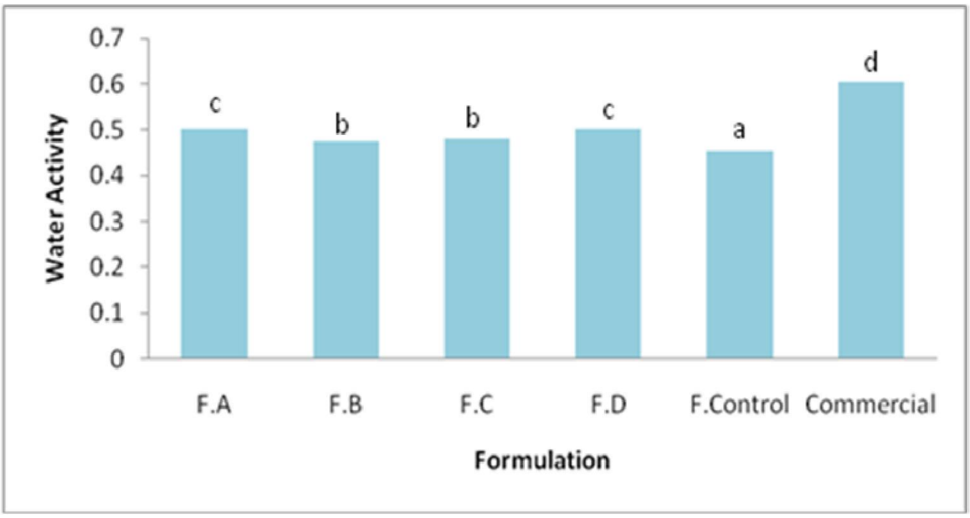

Figure 4. Water Activity values of Jelly candy.

Notes:F.A/Formula A: carrageenan 40%, konjac 25%; F.B/Formula B: carrageenan 35%, konjac 30%; F.C/Formula C: carrageenan 30%, konjac 35%; F.D/Formula D: carrageenan 25%, konjac 40%; Control/Control: carrageenan 65%, konjac 0%; Commercial: commercial product; Different letters superscripted on the results indicate significant difference (P>0.05) between each parameter tested.

The statistic test of texture parameter resulted in at least one sample differed significantly from the others. In terms of texture, Control was the least accepted by panelists with value of 2.33±0.98, which is interpreted- as hard, sticky, and brittle texture, while Formula D was the most accepted by panelists with value of 4.13±0.52, which can be deduced that it had flexible, non-sticky and elastic texture. However, Duncan test showed that Formula D was not significantly different from Formula A, Formula B, and Formula C.

The statistic test elasticity evaluation resulted in at least one sample differed significantly from the others. In terms of elasticity, Control was the least

Table 5. Sensory test of Jelly Candy

Parameters	Control			Formula A			Formula B			Formula C			Formula D		
Texture	2.33	±	0.98 [a]	3.67	±	0.72 [b]	4.00	±	0.76 [b]	4.00	±	0.76 [b]	4.13	±	0.52 [b]
Elasticity	2.64	±	1.22 [a]	3.33	±	0.82 [b]	3.71	±	0.73 [b]	3.43	±	0.85 [b]	3.67	±	0.72 [b]
Transparency	2.60	±	0.74 [a]	3.80	±	0.77 [b]	4.07	±	0.46 [b]	4.07	±	0.47 [b]	4.20	±	0.41 [b]
Odor	3.67	±	0.82 [a]	4.20	±	0.56 [b]	4.14	±	0.86 [b]	4.00	±	0.78 [ab]	4.33	±	0.62 [b]
Taste	3.67	±	0.62 [a]	4.13	±	0.52 [b]	4.00	±	0.53 [b]	4.20	±	0.56 [b]	4.13	±	0.74 [b]
Acceptability	2.20	±	0.41 [a]	3.40	±	0.83 [b]	3.73	±	0.59 [b]	3.67	±	0.72 [b]	4.07	±	0.46 [c]

Notes: Formula A: carrageenan 40%, konjac 25%; Formula B: carrageenan 35%, konjac 30%; Formula C: carrageenan 30%, konjac 35%; Formula D: carrageenan 25%, konjac 40%; Control/ Control: carrageenan 65%, konjac 0%; Commercial: commercial product; Different letters superscripted on the results indicate significant difference ($P>0.05$) between each parameter tested.

accepted by panelists with value of 2.64±1.22, which is further deduced that it was slightly elastic, while Formula B was the most accepted by panelists with value of 3.71±0.73, which implies that it had elasticity nearly ideal for jelly candy. Nevertheless, Duncan test showed that Formula B was not significantly different from Formula A, Formula C, and Formula D.

The statistic test of transparency score for jelly candy showed that at least one sample differed significantly from other products. In terms of transparency,Control was the least accepted by panelists with value of 2.60±0.74, which implies that the product was slightly cloudy and slightly unattractive; while Formula D was the most accepted by panelists with value of 4.20±0.41, which implies that it was transparent, clean, and attractive. Yet, Duncan test indicates that Formula D was not significantly different from Formula A, Formula B, and Formula C.

The statistic of odor score resulted in at least one sample differed significantly from the others. In terms of aroma or odor, Control was the least accepted by panelists with value of 3.67±0.82, which implies that the aroma of the product was detected yet very light, while Formula D was the most accepted by panelists with value of 4.33±0.62, which means that the flavor was fragant and delicant. However, Duncan test showed that Control was not significantly different from Formula C but different significantly from other formulations. On the other hand, Formula C, gave no significant difference to Formula B, Formula A, and Formula D.

In terms of taste, Formula Control was the least accepted by panelists with value of 3.67±0.62, which is further deduced that the taste of the product was sweet and sour typical of jelly candy, with a little taste of seaweed, while Formula D was the most accepted by panelists with value of 4.20±0.56, which means that the taste was sweet and sour, typical of jelly candy, and no taste of seaweed. On the other hand, Duncan test showed that Formula C was not significantly different from either of the Formula A, Formula B, or Formula D.

A lot of studies have proved that food appearance can affect the perception of the taste. Control, which was the least accepted by panelists for transparency attribute that contributes to the appearance of the product, was also the least accepted for taste attribute.

The acceptability scores for each jelly candy are tabulated in Table 5. The statistic analysis was performed using univariate analysis of variance and Duncan test. The statistical data resulted in significant differences to the level of acceptance of jelly candy. The least accepted jelly candy was Control with the acceptance value of 2.20±0.41, which was equal to “dislike slightly”. Control was different significantly from other formulations. Formula A was the second least accepted by panelists, yet it was not significantly different from either of the Formula B, or Formula C. Formula D was the most accepted by panelists with value of 4.07±0.46 which equals to “like” the product. Nevertheless, Formula D was not significantly different from Formula B and Formula C.

4. Conclusion

The important parameter in jelly powder is the physical properties since hydrocolloid is mainly used to improve texture. Compared to control it had proven that konjac worked synergistically with carrageenan to improve gel strength, elasticity, viscosity and to reduce syneresis.

Proportion of *k*-carrageenan to konjac in jelly candy production had an effect to the physicochemical of the resulted product. Formula A with *k*-carrageenan and konjac ratio of 40: 25 produced jelly candy texture closed to the commercial one. The physicochemical properties of these product were hardness of 470.7 g, elasticity of 4.5 mm, stickiness of 36.15 g and a_w of 0.5. However in sensory evaluation formula A, B, C and D showed that the proportion of *k*-carrageenan to konjac in jelly candy had no effect. While jelly candy product without konjac, was significanty different from other formula.

Based on that result, the best formulation in jelly candy production was formula A.

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