

The Effect of Carrageenan Concentration on the Physical and Chemical Properties of Gummy Turmeric Acid Jamu

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ABSTRACT

Turmeric acid Jamu is an Indonesian herbal drink that made from turmeric and tamarind. The herbal medicine industry in Sleman Yogyakarta produces Turmeric acid Jamu, but the concentration of curcuminoid has not been determined. Consumers of Turmeric acid Jamu are limited to women and adults. Children rarely want to consume jamu, even though the curcuminoid in turmeric can increase appetite, especially for toddler. Innovation is needed to process Turmeric acid Jamu into products that more desirable and efficacious. Gummy is made with the addition of a gelling agent so that the texture is chewy. Carrageenan is a gelling agent made from seaweed and is safe for food products. The purpose of this study was to determine the effect of variations in carrageenan concentrations on physical and chemical properties, also to determine the optimum concentration of carrageenan in gummy Turmeric acid Jamu according to the Indonesian National Standard on soft candy. This research is an experimental laboratory with variations in the concentration of carrageenan (7.5%; 8.0%; 8.5%) and Turmeric acid Jamu as the main ingredient. The test include organoleptic, pH, weight uniformity, water content, disintegration time and the respondent acceptance test. The concentration of curcuminoid using spectrophotometry UV-VIS method and statistical analysis. The results showed that carrageenan concentration affected organoleptic, weight uniformity, moisture content, and disintegration time, but did not affect pH. The curcuminoid concentration of Turmeric acid Jamu was 1.47% and the gummy was 0.03% (w/w). The carrageenan concentration of 8.0% is the optimum formula because it meets the quality requirements of the gummy and is the most preferred by the respondents.

Keywords: gummy; turmeric acid jamu; carrageenan; physical and chemical properties; curcuminoid

INTRODUCTION

Jamu is an Indonesian traditional herb that consumed since long time. Jamu has a delicious and refreshing taste and has benefits to prevent disease and improve health [A'yunin *et al.*, 2019]. Jamu is commonly known as jamu gendong, which is a herbal drink that made from fresh ingredients, cannot be stored for long time and usually consumed in fresh, one of which is produced by home industries. A home industry that is growing rapidly in producing jamu gendong is herbal medicine of home industry located in Sleman, Yogyakarta. Many people consume turmeric acid jamu, it is made from turmeric, tamarind fruit, water, and sugar. Several studies have shown that turmeric has benefits as an antioxidant, analgesic and can increase appetite (Shan and Iskandar, 2018). Tamarind has benefits as an antipyretic and anti-inflammatory [Widiatami *et al.*, 2018]. Turmeric rhizome contains curcuminoid compounds which are a group of phenolic compounds as much as 3-5% w/w. This component concentration can decrease to 1-2% w/w after formulation process (Shan and Iskandar, 2018).

The development of technology in producing herbal medicine, as an effort to process herbal medicine into products that are liked by the community and are durable in storage and still efficacious for health. One of them is gummy candy product. Gummy is a soft-textured processed product, which is processed usually mixed with hydrocolloid components such as jelly, gum, pectin, carrageenan, gelatine, starch and others to produce a chewy product (Indonesian National Standard Agency, 2008). Gummy was chosen because it has a sweet taste and chewy texture, making it attractive to both adults and children. Gummy formulations with herbal ingredients can be an alternative so that children and adults can consume herbal medicine practically. The curcumin compounds in turmeric can help increase appetite, so it can be used as an appetite supplement (Syarif *et al.*, 2015). The chewy texture of candy can be produced by adding ingredients that contain gelling agents such as carrageenan. Carrageenan is a hydrocolloid compound extracted from red seaweed (*Rhodophyceace*) (Nuansa *et al.*, 2017), which functions as a stabilizer, thickener, and gelling agent so that it

Table I. Turmeric Acid Jamu Gummy with variation Carrageenan

Ingredients	Turmeric Acid Gummy Formula (grams)		
	F1	F2	F3
Carrageenan	7.5	8.0	8.5
Glycerine	13.7	13.7	13.7
Citric Acid	0.25	0.25	0.25
Sodium benzoate	0.75	0.75	0.75
Turmeric Acid Jamu	77.8	77.3	76.8

F1 : Turmeric Acid Jamu Gummy with 7.5% Carrageenan concentration; F2 : Turmeric Acid Jamu Gummy with 8.0% Carrageenan concentration; F3 : Turmeric Acid Jamu Gummy with 8.5% Carrageenan concentration

can affect the characteristics of gummy (Winarno, 2008).

Carrageenan was chosen as a gelling agent because it is safe to use as a gelling agent or binding agent in the food and non-food industries (Ega *et al.*, 2016). According to Jumri *et al.* (2015) using of high levels of carrageenan can give a strong texture to gummy formula. Gummy was formulated in this study using carrageenan concentrations between 7.5%-8.5%. This is because the research conducted by Bachtiar *et al.* (2017) by using variations in carrageenan concentrations between 7.5-11.5% and red ginger extract produced the best candy products with a combination of 41.50% red ginger extract and 7.50% carrageenan. In that study, gummy produced slightly brownish color, ginger-flavored, slightly chewy texture, and spicy taste. Gummy produced has met the quality standards of jelly candy in the Indonesian National Standard 3574-2-2008 based on parameters of moisture content, sugar content and ash content. Meanwhile in research conducted by Rismandari *et al.* (2017) in making gummy with the combination of gelatin and carrageenan, the best hedonic results were obtained at a combination of 0% gelatin and 8% carrageenan. According to Badan Pengawas Obat dan Makanan Indonesia Regulation No. 24 of 2013, the use of carrageenan as a food additive is permitted in sufficient quantities needed to produce the desired effect. Carrageenan concentrations between 7.5% - 8.5% can produce candy that has characteristics in accordance with the Indonesian National Standard for soft candy and gets a good hedonic test. This study aims to formulate turmeric acid jamu gummy as an innovations of herbal products into a trend product in society by adding variations in the

concentration of carrageenan in gummy formula.

MATERIAL AND METHODS

Tools

Analitical neraca (Precisa® EP 220A, S/N 4600349 , Made in : Swiss), stove (Quantum® QGC 201 E, Made in : Italia, flask disk (Pyrex® 25 mL, made in Jerman), moisture analyzer (Ohaus® MB25, made in China), disintegration tester (Guoming® BJ-2, made in China), spektrofotometri UV-Vis (Genesys 10S UV-Vis made in China), micropipette (Dragonlab® 100-1000 µl, made in China), pen type pH meter (ATC nutron.tech® PH-009-A, made in China), thermometer alcohol (Gea® 10/110 C S-006, made in Jerman).

Material

Turmeric acid Jamu from home industry Jamu Jeng in Yogyakarta, Food Grade Carrageenan SR.EC.01®, 70% technical grade alcohol and sodium benzoate (Repackaged by CV. De Access at Jalan Sutandyo, Boyolali), food grade glycerin, citric citrate, and aquadest (Repackaged by CV. Agung Jaya at Jalan Yosodipuro No. 83, Surakarta), ethanol 96% food grade product code 201085 (PanRec ApliChem ITW Reagents), Curcumin Merck KGaA® Specification 8.20354.0010 (Produksi Sigma Aldrich).

Method

Turmeric Acid Gummy Formulation

Turmeric acid jamu as the main ingredient of gummy with a variation of carrageenan concentration is 7.5 g; 8.0 g and 8.5 g. Based on the development of research results by Bachtiar *et al.* (2017), in this study used carrageenan with a concentration of 7.5-8.5 g

based on trials conducted with differences in ingredients formula.

Carrageenan is dissolved in turmeric acid jamu while stirring until dissolved and homogeneous at temperature of 80 °C for 10 minutes. Carrageenan can dissolve at temperatures above 70 °C (Caroline and Pratiwi, 2018). The mixing temperature was lowered until 40 °C while stirring until thick. The mixture of carrageenan and turmeric acid jamu are added with glycerin, citric acid, and sodium benzoate. After all the ingredients are mixed and homogeneous, then pour into a candy mold at room temperature (25 °C). Gummy is packaged in plastic and stored in a dry place.

Turmeric Acid Jamu Gummy Physical and Chemical Properties Test

Moisture Content

A total of 2 grams of gummy were placed on aluminum foil which had previously been tared on the Moistur Analyzer. Then heated to a temperature of 105 °C or until constant weight (Agistia *et al.*, 2015). Moisture content value in the form of percent.

Weight Uniformity

The weight uniformity test was carried out by weighing 20 candies one by one then calculating the average of weight, percent deviation of weight (standard deviation), and the coefficient of variation (Deviarny *et al.*, 2015).

Dissolve Time

Dissolve time test is conducted using disintegration tester. Put 5 of gummy in the basket, then the basket is raised and lowered until the gummy is crushed. Gummy is declared dissolved if no part of gummy is left on the gauze, except for fragments that come from coating substances (Deviarny *et al.*, 2015).

Reseption test of Turmeric Acid jamu Gummy

This test is carried out by the panelists to find out which formula is preferred with total of 20 respondents were given samples one by one and then asked to provide an assessment based on the rating scale provided (Indonesian National Standard Agency, 2008). The level of preference was assessed based on the organoleptic form of turmeric acid jamu gummy, included taste, texture, and smell. The level of

preference will be measured based on a scale of like: score 4 is very like, score 3 medium like, score 2 is not so good, and score of 1 is dislike.

pH test

pH test of gummy is carried out with a pH meter. A total of 1.0 gram of gummy was diluted with 10 mL of aquadest (Rakhmayanti and Hastuti, 2019).

Concentration of Curcuminoid of Turmeric Acid Jamu Gummy

Standard Curve of Curcumin

Curcumin Standard is weighed of 10 mg, then dissolved with ethanol 96% add 100 mL in volumetric flask, then homogenized (stock 1). Stock 1 solution, then scan the absorbance at a wavelength range of 400-800 nm (Mohammad *et al.*, 2007). Put the solution from stock 1 solution then make series of solution of 0.1; 0.2; 0.3; 0.4 and 0.5 mL then diluted with ethanol 96% add 10 mL into volumetric flask, so that solution series were obtained of 1; 2; 3, 4 and 5 mg/L. Read the absorbance value with the maximum wavelength that has been obtained. The result of the absorbance then calculated in the standard curve equation $y = bx + a$.

Curcumin concentration of Gummy

Weigh of 0.5 grams gummy that fulfill the requirement of soft candy based on SNI, then dissolved add 10 mL of ethanol 96% in volumetric flask. Gummy solution then take of 1.0 mL and diluted with ethanol 96% ad 10 mL in volumetric flask. Scanning at maximum wavelength of curcumin, ethanol as a blanko. Then calculated the curcumin content of gummy with the standard curve equation that has been obtained

Data Analysis

The data from the physical and chemical test obtained were then analyzed using the IBM SPSS Statistics 21 program with the One Way ANOVA test to determine the significant differences between the three forms on each test preparation. The normality test was carried out with Shapiro-Wilk. If the One Way ANOVA test data is different, then proceed with the Post Hoc test using the Tukey HSD method at the significance level $\alpha = 0.05$. In the reseption test results, the data will be calculated as a percentage value.

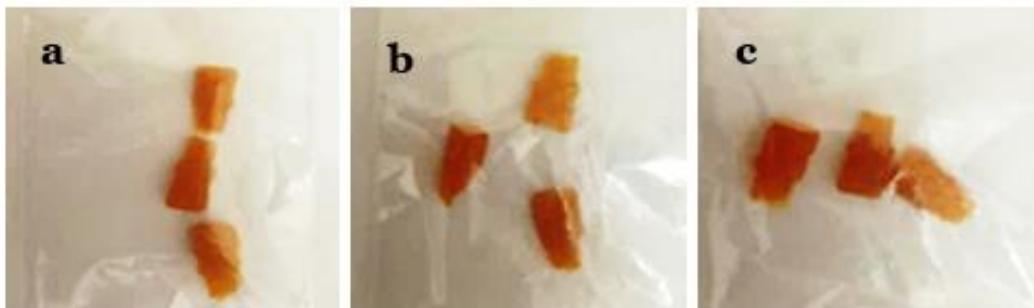


Figure 1. Results of Turmeric Acid Jamu Gummy with carrageenan concentration of 7.5% for Formula 1; Formula 2 with 8.0% carrageenan and Formula 3 with 8.5% carrageenan concentration

RESULT AND DISCUSSION

Organoleptic Test

Organoleptic evaluation of turmeric acid jamu gummy including color, aroma, texture, and taste shows that the gummy does not change during storage for 28 days. The color of a food product can be formed by the presence of pigments that are naturally contained in food ingredients or coloring agents added to the food product (Andarwulan *et al.*, 2011). Gummy has a brownish orange color. This is due to the original color of turmeric acid jamu and the carrageenan concentration used in the formula. The addition of carrageenan concentration affects the color intensity of gummy, where the higher of carrageenan concentration resulting the gummy with brown color. This is in line with the statement of Harijono *et al.* (2011) that a high concentration of carrageenan resulted a solid jelly candy but the intensity of the color become darkness. The difference in texture of gummy is caused by the concentration of carrageenan and turmeric acid jamu used. The higher concentration of carrageenan effected to the more chewy and stronger of jelly candy texture. According to Fajarini *et al.* (2018) carrageenan has a stronger gel strength than gelatin. The taste obtained from the turmeric acid jamu gummy is the sweet and sour taste obtained from the turmeric acid jamu. The higher of carrageenan concentration reduces the sweetness of the gummy. All formula of gummy have the same color, aroma, and taste there are brownish orange in color, has a smell of turmeric herbs, and has a sweet and sour taste due to the turmeric acid jamu used.

Moisture Content

Moisture content is an important component in edible food affect to the texture and appearance of food. Moisture content is an important factor that affects product quality. According to Winarno (2008) the moisture content in food can determine the freshness and shelf life of food. The results of the analysis of moisture content of gummy showed that the higher the amount of carrageenan concentration caused a reduction in moisture content. The moisture content of turmeric acid jamu gummy in this study was according to established standards. The moisture content range in this study was 10.47% - 13.23%. The result was higher than the previous research conducted by Dhina *et al.* (2019) which has moisture content of 4%. The moisture content in this study was higher than the comparative (commercial) moisture content made of gelatin which had a water content of 7.83%. This difference is due to the manufacture of turmeric acid jamu that used contains high concentration of sugar so carrageenan difficult to dissolve compared to gelatin (Rismandari *et al.*, 2017). The effect of different carrageenan concentrations on moisture content of gummy can be determined by the One Way Anova test. The results obtained indicate the significance of the normality and homogeneity test > 0.05 . There is an influence between the carrageenan concentration and the moisture content of gummy, where the higher of carrageenan concentration, will decrease of moisture content. This is because carrageenan is a hydrocolloid compound that easily binds water. Then the Post Hoc test was carried out

Table II. Results of Physical and Chemical properties of Turmeric Acid Jamu Gummy

Formula	pH	Moisture content (%)	Weigh uniformity (mg)	Dissolve Time (minute)
F 1 (carageenan 7.5%)	5.1±0.10 ^a	13.23±0.39 ^a	887.0±0.015	19.19±0.09 ^a
F 2 (carageenan 8.0%)	5.2±0.10 ^a	10.61±0.19 ^b	880.5±0.023	20.34±0.13 ^b
F 3 (carageenan 8.5%)	5.1±0.15 ^a	10.47±0.18 ^c	883.5±0.017	22.27±0.15 ^c

with the results that there were significant differences in F1 with F2 and F3. The moisture content of turmeric acid jamu gummy from this study does not exceed by the Indonesian National Standard (2008), which is 20% of moisture content. So that the water content in the gummy preparation in this study qualifies as a soft candy product.

Weight Uniformity

This weight uniformity test was carried out based on the research conducted by (Deviarny *et al.*, 2015), because there is no requirement for uniformity of weight in jelly candy preparations that can be used as a comparison. This weight uniformity test to determine the homogeneity of gummy produced. The results showed that the turmeric acid jamu gummy products had an average weight between 880.5-887.0 mg. F1 has smallest value of coefficient of variation (CV), so that F1 has the best weight uniformity of gummy.

Dissolve Time

The dissolve time test is intended to determine how fast the candy is slowing down dissolves in body. The dissolve of gummy is influenced by the entry of water into the gummy. The easier of water to enter into gummy effected to dissolve time (Deviarny *et al.*, 2015). Gummy dissolve time which was measured showed at table II. Each formula shows the variation in the dissolve time. This is due to the differences in carrageenan concentration that used. The higher of carrageenan used, effect to the longer of solubility time. Meanwhile, comparison jelly candy (commercial) dissolve time is 15.2 minutes. Commercial jelly candy using gelatin as gelling agent. The statistical analysis results obtained are the significance value >0.05 which means that there is a significant difference. The difference in carrageenan concentration in each formula affects to disintegration time of gummy. Then the Post Hoc test was performed with F1

results significantly different from F2 and F3. In previous study conducted by Deviarny *et al* (2015) on the manufacture of Kapulaga fruit essential oil gummy with gelatin had a dissolve time of 15.6 - 20 minutes. The difference in disintegration time related to gelling agent used where in that study using gelatin as the basic gel-forming ingredient.

pH Value

The pH results of turmeric acid jamu gummy are classified as acidic because the pH value is below neutral pH (pH 7) which has a pH ranging of 5.1-5.2. According to Rahadian *et al.* (2017) jelly candy products have a pH value ranging from 4.5-6.0. To determine the effect of carrageenan concentration variations on the pH of the preparation, the One Way ANOVA test was performed. The results of the pH normality test of gummy preparations using the Shapiro-Wilk method showed a significance value of > 0.05, so the data was normal. The results of pH analysis showed that there was no significant difference between the three gummy formulas with different carrageenan concentrations. The pH test results in this study were higher than comparison jelly candy (commercial) which had a pH value of 4.7. Based on the statement from Rahadian *et al.* (2017) the use of carrageenan can increase the pH of the product because carrageenan has pH value of 7. The pH value of turmeric acid jamu gummy in this study is influenced by the acid contained in the gummy formula. The acidic ingredients in the gummy formula are tamarind and citric acid. The tamarind fruit has an acidity level of 12.3-23.8% w/w (Soemardji, 2007). Meanwhile, the addition of citric acid acts as an acidulant, so it can keep the pH of the gummy acidic. The acidic pH value can inhibit the growth of spoilage microbes so that gummy has a relatively long shelf life (Dhina *et al.*, 2019). In addition, the acidic state will maintain the stability of the curcumin compound (A'yunin *et al.*, 2019).

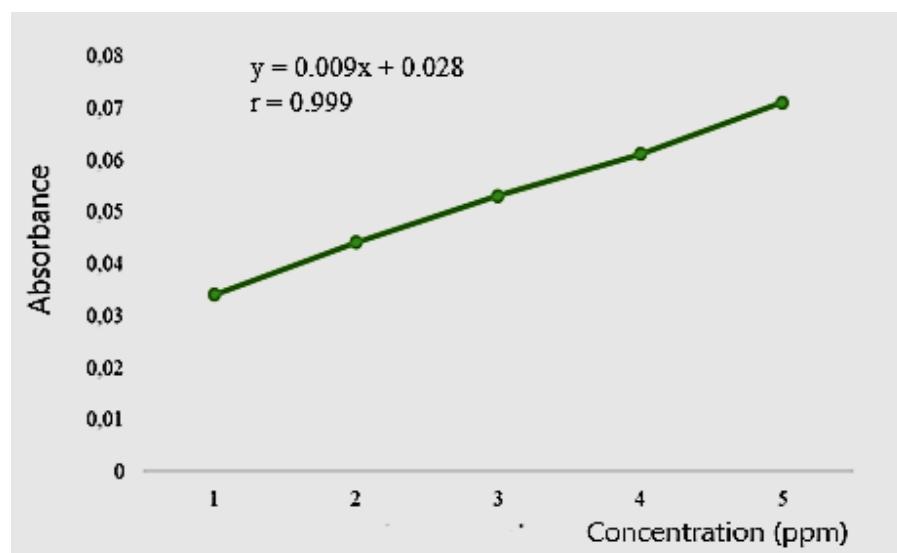


Figure 2. Result of Standard Curve of Curcuminoid into ethanol 96% solvent

Reseption Taste Test

The reseption taste test was carried out by 20 panelists that have obtained research permits and ethical eligibility permits at April from the Faculty of Medicine, Sebelas Maret University with Number 32 / UN27.06.6.1 / KEPK / 2020. The reseption taste test was conducted to determine consumer acceptance of turmeric acid jamu gummy products. Panelists assessment of taste is defined as acceptance of taste or the flavor produced by the product (Zia *et al.*, 2019). Taste is influenced by several factors, there are temperature, concentration, chemical compounds, and the presence of interactions of components in formula (Fajarini *et al.*, 2018). The result of the favorite test of turmeric acid jamu gummy obtained the highest value obtained was F2 (Carrageenan 8.0%: Jamu 77.3%) as much as 40% of the panelists acceptance. While the lowest value was obtained in F1 (Carrageenan 7.5%: Jamu 77.8%). From the results of this study it can be stated that the panelists like the medium sweet and sour taste compared to the strong sweet and sour taste. The use of turmeric acid jamu which were high at F1 (77.8%) caused the gummy taste to be sour, thus affecting the panelists preference. According to the opinion of Harijono *et al.* (2001) increasing the amount of carrageenan produces a strong gel and sweet taste.

Curcuminoid Contains of Turmeric Acid Jamu Gummy

The turmeric acid jamu produced by Jamu jeng In Home Industry contains of 16.25 g/250 mL of turmeric (concentration of 65,000 mg/L). Based on the opinion of Shan and Iskandar (2018), curcumin compounds will decrease in concentration of 1-2% after formulation process. The curcumin content measured was F2 with carrageenan concentration of 8.5 g. This is because the F2 gummy has physical test results, included moisture content, pH, organoleptic, and the most favored by the 20 panelists. Scanning of the maximum wavelength is carried out in the wavelength range of 400-800. In a study conducted by Kusnadi and Nugraha (2018), the maximum wavelength of curcumin was 460 nm with a range of 410-500 nm. Meanwhile, in this study the maximum wavelength was 459 nm. The difference between the wavelength results in this study and the literature can be caused by differences in the instrument used in the analysis. But this difference is still within the tolerance limit, because according to the Indonesian Ministry of Health (2014) the wavelength has an allowable limit of ± 1 nm for the 200-400 nm range.

The results of the absorbance value of the sample measurements of turmeric acid jamu gummy obtained with 3 replications ther are

0.046; 0.045; 0.047 and a concentration of 2 mg/L. So that jelly candy can be consumed because it is still contains curcumin compounds. The curcumin content of gummy is 0.03% (w/w) each 500 mg by weight of gummy. Meanwhile, the curcumin content of turmeric acid jamu before formulation process was 1.47%. From these results there was a decrease in curcumin concentration between jamu and gummy, this was due to the formulation process carried out. Decreased curcumin concentration by 2%. However, the results of decreasing curcumin concentration are in accordance with the opinion of Shan and Iskandar (2018) which states that curcumin compounds can experience a 1-2% decrease after formulation.

CONCLUSION

The difference in the concentration of carrageenan in the gummy preparation of turmeric acid jamu gives a difference to the physical properties there are moisture content, dissolve time, and taste of the gummy, but did not effect to pH value. The high concentration of carrageenan will decrease the moisture content, but longer the dissolve time and the texture of the candy becomes chewy. F2 (carrageenan 8.0%) has good characteristics, because it meets the quality requirements of jelly candy based on the Indonesian National Standard. The curcumin content in F2 was 0.03% w/w each 500 mg preparation. Gummy of F2 (carrageenan 8.0%) was the most preferred formulas by panelists.

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