

THE EFFECT OF ADDING GELATIN AND SALT SOLUTION TO OFF-GRADE SAPODILLA JELLY CANDY THROUGH THE PROCESS OF REDUCING ITS TANNIN CONTENT

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ABSTRACT

The young sapodilla fruit will take when harvesting is brownish green and has an astringent taste, called off-grade sapodilla fruit. The astringent taste of the fruit is due to the high tannin content. Soaking with a salt solution is a treatment done to reduce the astringent taste so that the fruit can continue as raw material for making jelly candy. Gelatin is added as a gelling agent to get a good jelly candy. This study aimed to determine the effect of adding gelatin and salt solution used in the manufacture of off-grade sapodilla fruit jelly candy, which has been studied for its tannin content reduction. The research method used is an experimental method followed by a Factorial Randomized Block Design test consisting of 6 treatments. The tested treatment consisted of two factors: the first factor was soaking sapodilla off-grade with variations in salt solution of 2%, 4%, and 6%, and the second factor was gelatin concentration of 18% and 20%. The results showed that the off-grade sapodilla sample gave the greater salt concentration was given, the more the salt could reduce the amount of tannin content. In jelly candy, the tannin content obtained was decreased compared to the tannin content of off-grade sapodilla fruit. The tannin is due to the unstable or too high cooking temperature. Based on the results of the texture test, found that the L2G2 treatment (4% salt solution, 20% gelatin) was closest to the commercial texture, while based on the organoleptic test, the L3G1 treatment (6% salt solution, 18% gelatin) had the highest value by the panellists

Keywords: Gelatin, jelly candy, off-grade sapodilla fruit, tannin, texture

INTRODUCTION

According to Arbaiah (2019), there are young sapodilla fruits that are also taken when harvesting. Generally, the sapodilla is discarded or used as feed by fruit farmers. This young sapodilla fruit has a size ranging from 4-5 cm, brownish-green, and when ripe, the young sapodilla fruit does not experience perfect ripening and has a sour taste. In other words, this type of young sapodilla fruit is said to be an off-grade sapodilla fruit.

According to Awika, Yang, Browning, & Faraj (2009), high tannin levels cause an astringent and bitter taste in foodstuffs. The fruit's bitter, astringent, and sour taste does not make it acceptable to the public, so it needs to be handled to reduce it so that the flavour is good to the panellists when the fruit is processed into a product. Soaking with the salt solution is the most common treatment to reduce the astringent taste in fruit. The price is relatively affordable in off-grade sapodilla

fruit that has gone through soaking treatment with a salt solution to continue to be the raw material for making jelly candy.

Jelly candy is one of the food products that is liked by everyone, from children to adults. Jelly candy is candy made by adding fruit juice, a mixture of gelling ingredients, or flavourings to create various flavours with clear and transparent physical forms (Atmaka, Nurhartadi, & Karim, 2013). Jelly candy is generally made from gelatin with the addition of gelatin as a thickener. Gelatin is a natural product obtained from the partial hydrolysis of collagen. The addition of gelatin can affect the physical and chemical properties of the product. One of the most important factors in gelling is the gelatin concentration in the mixture because the gel will only form to a certain extent. If the gelatin concentration is too low, the gel will become soft, or no gel is included, but if the concentration of gelatin used is too high, the gel formed will be stiff (Vail et al. 1978 in Herutami, 2002).

Based on the description above, the researcher studied the reduction of tannins in off-grade sapodilla fruit by using a salt solution so that could continue it in the manufacture of jelly candy by examining the concentration of gelatin used so that it could produce processed products in the form of off-grade sapodilla fruit jelly candy which the panellists favoured.

MATERIALS AND METHODS

Tools and Materials

The main ingredient used in this research is brown off-grade Sukatali variety with characteristics of 4-6 cm diameter, brownish-green skin, round shape, has a lot of sap, not sweet/astringent. Other ingredients used include gelatin, citric acid, high fructose syrup (HFS), and water. The chemicals used in this study were distilled water, table salt solution, methanol, folin denis reagent (sodium tungstate, phosphomolybdic acid,

phosphoric acid), saturated Na_2CO_3 , and tannic acid.

The tools used in this study were glass containers/glass jars, paper packaging, blenders, filters, knives, spatulas, bowls, pans, pans, stoves, basins, mixing spoons, scales, measuring cups, Texture Analyzer, spectrophotometer, vortex, cup aluminium, oven, desiccator, funnel, silica gel, analytical balance, stirring rod, magnetic stirrer, volumetric flask, krustang, Erlenmeyer, aluminium foil, filter paper, glassware for chemical analysis.

Methods

Jelly Candy Production

The sapodilla fruit was treated with 2%, 4%, and washed 6% salt solutions for 24 hours at room temperature (25°C) to remove the solution still attached to the fruit. Then the flesh of the fruit is separated from the seeds of the fruit. The flesh of the fruit is mashed using a blender with a ratio of water and fruit 10:1. The pulp is then filtered using a filter cloth to separate the pulp from the juice. Sapodilla juice as much as 500 ml is divided into two parts. Part I: 100 ml sapodilla juice added 50 grams of fructose syrup/HFS and 0.2 grams of citric acid into a Teflon pan and heated for 5 minutes to 90°C while continuously stirring using a wooden spoon. Part II: of sapodilla fruit juice 400 ml was used to dissolve gelatin whose concentration had been determined in the research preparation stage. Sapodilla juice II was heated at 60°C, then added gelatin little by little and heated for 3 minutes while stirring until all gelatin was dissolved. Sapodilla juice I mixed with sapodilla juice II, then heated into jelly candy dough. The jelly candy dough was cooked for 7 minutes at 90°C while continuously stirring. After that, the jelly candy mixture is poured into an aluminium pan. Then the jelly candy was allowed to cool for 1 hour at room temperature and continued cooling in the refrigerator at 5°C for 24 hours. Furthermore,

the jelly candy was placed at room temperature for 1 hour, cut into pieces, and then analyzed.

Experimental Design

The treatment carried out was making jelly candy with off-grade sapodilla, which had gone through the astringent reduction process with 2%, 4%, and 6% salt solutions. The study was conducted using an experimental method using a factorial Randomized Block Design consisting of 6 treatments and three replications. The treatment that was tried consisted of two factors.

The first factor is soaking sapodilla off-grade with a variation of salt solution (L):

L1 = Immersion of 2% salt solution

L2 = Immersion of 4% salt solution

L3 = Immersion of 6% salt solution

The second factor is gelatin concentration (G):

G1 = Addition of 18% gelatin

G2 = Addition of 20% gelatin

Data Analysis

The main response variables observed in this study are as follows Tannin content (AOAC, 2005 modification), Texture which includes hardness, springiness, cohesiveness, chewiness, and gumminess using the TA-XT2 Texture Analyzer (Stable Micro System, 2003) and Hedonic organoleptic test (Soekarto, 1985).

RESULTS AND DISCUSSION

Effect of Immersion in Salt Solution on Tannin Content of Sapodilla Off grade

Tannin compounds that are quite high in fruits can provide astringent taste, so treatment is needed to reduce the astringent taste in the sapodilla. Off-grade sapodilla fruit that has been treated with immersion in several concentrations of salt solution, then tested and measured for tannin content. Table 1 shows that the greater the salt concentration is given to the off-grade sapodilla sample, the

more the salt can reduce the number of tannin contents. Because the greater the concentration of salt given and the long immersion time, the more tannin content will diffuse out of the cell so that the tannin remaining in the material decreases (Reza.S, 2016).

The mechanism of NaCl in reducing the tannin content of fruit is as follows; The gallic acid found in tannins, when reacted with a salt solution (NaCl), will produce sodium gallate. Similar to gallic acid, ellagic acid will react with NaCl and produce sodium elagate. Gallic acid and ellagic acid are compounds found in tannins that cause fruit's bitter and astringent taste. Sodium gallate and sodium ellagic acid are salts that are more soluble in water than in the form of gallic acid and ellagic acid, which are weak acids. Weak acids will partially dissociate in water, and if they are in the form of their salts, more parts will dissociate. Sodium gallate and sodium elagate will dissolve with the liquid from the fruit and cause a less bitter and astringent taste (Tortoe, 2010).

The addition of salt can increase the osmotic pressure so that losing water from the material is getting bigger. In addition, the addition of salt also causes the release of sugar, dissolved protein, minerals, and other substances carried by liquids that come out of food (Yuliana, 2007). The more salt is added, the more water and other implications come out of the food, but this osmosis process will stop when the concentration in the food and the environment has reached a state of equilibrium.

Effect of Addition of Gelatin on Tannin Levels of Sapodilla Jelly Candy Off grade after Immersion in Salt Solution

Tannins are a set of polyhydroxy phenols that can be distinguished from other phenolic compounds because of the nature of tannins that can precipitate protein (Pudjiaji and Tintin, 1994 in Sa'adah (2010). The

protein contained in off-grade sapodilla jelly candy is gelatin. Based on Table 1, the average tannin level in off-grade sapodilla jelly candy is not too high because it goes through the cooking process. Based on the research of Mutmainnah, Chadijah, & Qaddafi (2018), a temperature of 85oC increased tannin levels and at a temperature of 100oC showed a decrease in tannin levels

caused by too much water. In addition, according to Schuerch (1968), based on the chemical properties of tannins, they will decompose into pyrogallol, pyrocatechol, and phloroglucinol when heated to a temperature of 210°F-215°F (98, 89°C-101.67°C). So it is possible that the tannins contained in the jelly candy decrease due to the high temperature during cooking.

Table 1. Tannin content of Sapodilla Fruit and Off grade Sapodilla Jelly Candy

Off-Grade Sapodilla Fruit		Off grade Sapodilla Jelly Candy	
Treatment	Tannin Content (mg/g)	Treatment	Tannin Content (mg/g)
Immersion of 2% salt solution	21,186 ^c	L1G1	2,500 ^c
		L1G2	2,228 ^c
Immersion of 4% salt solution	19,114 ^b	L2G1	1,648 ^b
		L2G2	1,054 ^b
Immersion of 6% salt solution	16,118 ^a	L3G1	0,830 ^a
		L3G2	0,625 ^a

Note: The average treatment marked with the same letter states that it is not significantly different at the 5% test level. (Duncan Test)

However, the presence of gelatin affects the tannin levels in the jelly candy. The nature of tannins can precipitate protein, and all tannins cause a little or a lot of sediment when added with gelatin because it is a natural protein. Gelatin is a water-soluble

and digestible protein derived from collagen, which has been heated in boiling water by a dilute acid and base solution, consisting of 25% glycine and 25% proline and hydroxyproline (Noviyanty, Hepiyansori, & Agustian, 2020).

Table 2. Observation Result of Off grade Sapodilla Jelly Candy Texture

Treatment	Hardness (gF)	Springiness	Cohesiveness	Gumminess (gF)	Chewiness (mJ)
L1G1	418,935 ^a	0,946 ^a	0,817 ^a	337,797 ^a	313,542 ^a
L1G2	401,346 ^a	0,953 ^a	0,812 ^a	401,083 ^a	351,110 ^a
L2G1	359,056 ^a	0,945 ^a	0,813 ^a	331,874 ^a	282,984 ^a
L2G2	589,885 ^a	0,954 ^a	0,814 ^a	440,114 ^a	334,012 ^a
L3G1	436,194 ^a	0,925 ^a	0,829 ^a	368,402 ^a	274,858 ^a
L3G2	318,420 ^a	0,919 ^a	0,770 ^a	359,472 ^a	255,306 ^a

Note: The average treatment marked with the same letter states that it is not significantly different at the 5% test level

Jelly Sapodilla Candy Texture Off grade after Immersion in Salt Solution

a. Hardness Value

Hardness is the maximum peak at the first pressure or the first bite. Based on the data in the table, it shows that the results of the analysis of the hardness values of each treatment did not show a significant change, or it could say that the treatment did not affect the hardness value of the off-grade sapodilla jelly candy. However, compared to the average value obtained, jelly candy with the

addition of 20% gelatin has a higher hardness value than 18% gelatin. The hardness value of jelly candy is influenced by the concentration of gelatin added. Meanwhile, commercial jelly candy has an average hardness value of 311,221 gf. Based on the hardness value of commercial candy, the hardness of off-grade sapodilla jelly candy showed that the L3G2 treatment was close to the hardness of commercial jelly candy.

The more gelatin is added, the harder the candy will be. This is because the higher

the use of gelatin will produce a hard gel, while the lower the use of gelatin will produce a soft and sticky gel. According to Rahmi, SL., Tafzi, Fitry., Anggaraini (2012), gelatin concentration is one of the most important factors in gel formation. Gelatin concentration that is too low will cause the gel formed to be soft or not even gel. In candy with a higher gelatin concentration, the protein molecules will cross-link more closely to create a network, so the hardness of the confection will be higher.

The mechanism of gelatin in forming a gel is the crosslinking of polymer chains that form a cross-link (double helix) and produce large aggregates in the form of very strong nets, resulting in very small intermolecular spaces and free water in the gel being pushed out so that the gel become increasingly violent (Kaya, Küçükada, & Alemdar, 2019).

b. Springiness Value

The data in Table 2 shows that the analysis results of the springiness value of each treatment did not show a significant change, or it can say that the treatment did not affect the springiness value of off-grade sapodilla jelly candy. The springiness value for commercial candy is 1.092, while the springiness value for off-grade sapodilla jelly candy is 0.919-0.954. DeMan (1985) in Verawaty (2008) states that springiness/elasticity is expressed as the rate at which an object returns to its original shape after deformation (change of form). Springiness or elasticity can be defined as the recovery time between the end of the first bite and the beginning of the second bite. No units are used because this parameter calculates the time area difference.

c. Cohesiveness Value

Cohesiveness is defined as the ratio of the pressure area during the second compression to the first compression and has

no units. The data in Table 2 shows that the results of the analysis of the cohesiveness value of each treatment did not show a significant change, or it can say that the treatment did not affect the cohesiveness value of off-grade sapodilla jelly candy. However, when compared to the average value obtained. Commercial jelly candy has an average cohesiveness value of 0.86, which indicates its value is slightly above the off-grade sapodilla jelly candy. Jelly candy is easy to chew and swallow if it has a low cohesiveness value. Cohesiveness is the most important parameter in consumer acceptance of all ages (Kawano et al., 2017). Moreover, literature has shown that the cohesiveness of jelly candy is between 0.54-0.82 (Mutlu et al., 2018), which is similar to the results obtained in this study.

d. Gumminess Value

The hardness value influences the value of gumminess or stickiness. The higher the hardness value, the higher the gumminess value (Mutlu et al., 2018). The data in Table 2 shows that the results of the analysis of the gumminess value of each treatment did not show a significant change, or it can say that the treatment did not affect the gumminess value of off-grade sapodilla jelly candy. Based on the average value of gumminess in commercial candies of 266.32 gF, gumminess in off-grade sapodilla jelly candy has greater stickiness than commercial ones. The resulting data shows that the harder the texture of the jelly candy, the higher the stickiness. As in the research conducted by Oktavianti (2003), wherefrom the results of texture measurements, both hardness and stickiness, there is a tendency that the harder a candy is, the stickier it will be.

e. Chewiness Value

The chewiness is the energy needed to chew solid products until they can swallow them. The data in Table 2 shows that the

results of the analysis of the chewiness value of each treatment did not show a significant change, or it can say that the treatment did not affect the chewiness value of off-grade sapodilla jelly candy. The average weight of chewiness on commercial candy is 290.48. In contrast, the value of chewiness on off-grade sapodilla jelly candy, which has a value close to that of commercial candy, is in the L2G1

treatment. The highest chewiness value was in the L1G2 treatment with a 20% gelatin concentration. The factor that affects the chewiness parameter of jelly candy is gelatin. Gelatin is composed of polypeptides, resulting in higher elasticity, which results in increased elasticity when eaten (Mutlu et al., 2018).

Table 3. Results of Organoleptic Observations of Sapodilla Jelly Candy Off grade

Treatment	Color Hedonic	Flavor Hedonic	Aroma Hedonic	Texture Hedonic	Overall Hedonic
L1G1	1,780 ^a	1,913 ^a	1,861 ^a	3,933 ^a	2,792 ^a
L1G2	1,816 ^a	1,962 ^a	1,948 ^a	4,015 ^a	2,898 ^a
L2G1	1,896 ^b	2,062 ^b	1,947 ^b	4,021 ^b	3,009 ^b
L2G2	2,055 ^b	2,109 ^b	1,996 ^b	4,130 ^b	3,138 ^b
L3G1	2,137 ^c	2,183 ^b	1,996 ^b	4,132 ^c	3,146 ^b
L3G2	2,028 ^c	1,996 ^b	1,939 ^b	4,116 ^c	3,012 ^b

Note: The average treatment marked with the same letter states that it is not significantly different at the 5% test level. Value for each type of observation according to preference, with the following value provisions: 1= Dislike, 2 = Slightly Disliked, 3 = Ordinary, 4 = Like, 5 = Very Like

Organoleptic

a. Color

Colour is a factor that needs to be considered in product development because panellists judge a new food product first based on visual appearance. Colour is one of the visual forms that consumers feel (Winarno, 2002). Table 3 shows that the hedonic value of off-grade brown jelly candy colour ranges from 1.780-2.137 (do not like - somewhat dislike). In each treatment, different immersion has significantly different results. This is because the treatment has a significant colour difference. The resulting colour is almost other in each treatment because there is an influence from the concentration of gelatin or the concentration of salt solution during the sapodilla fruit soaking process.

Based on the hedonic value of the colour from the panellists who showed dislike and somewhat dislike because the colour of the candy produced generally had a yellowish-white colour and was transparent. As is the case, according to Atmaka et al.

(2013), jelly candy is a candy made from a mixture of fruit juices that has a clear and transparent physical form. The yellowish-white colour of sapodilla fruit juice and gelatin is thought to affect the colour produced from jelly candy products and the colour that is not attractive to consumers. The gelatin used in this study is beef gelatin in the form of granules. According to Aris et al. (2020), gelatin has a white or slightly pale yellow powder or granule colour. In sheet form, gelatin is transparent pale yellow.

b. Flavor

Taste has an important role in determining the acceptance of food. The sense of taste is divided into four flavours: sweet, salty, bitter, and sour. Panellists' acceptance of taste is influenced by chemical compounds, temperature, concentration, and interactions with other flavor components (Winarno, 2002). Table 3 shows that the hedonic value of off-grade sapodilla jelly candy flavor ranges from 1.913 to 2.183 (do not like - somewhat dislike). Based on the hedonic value of the taste from the panelists

who showed dislike and somewhat dislike because the taste of the candy produced was influenced by the sap from sapodilla that was still attached. So that the resulting taste has a slightly astringent taste. The resulting astringent taste indicates the content of tannins in the product. Another factor that also affects the taste of this off-grade sapodilla jelly candy is gelatin. Gelatin is used as a gelling agent in the food and pharmaceutical industries. The unique characteristic that gelatin can form is that it is "melt-in-mouth". This also affects the level of panellists' acceptance of the taste of the nutmeg jelly candy produced.

c. Aroma

Aroma is a very important factor in determining the level of consumer acceptance of a product. Before eating, consumers usually first smell the product's scent to assess whether or not the product is worth eating. According to Soekarto and Hubeis (2000), the scent in food is one factor that determines the delicacy of food-related to the sense of smell. Table 3 shows that the hedonic value of off-grade sapodilla jelly candy scent ranges from 1.861-1.996 (dislike). Based on the hedonic value of the panellists' taste, they did not like it because the scent of the candy produced was influenced by the off-grade sapodilla, which was still immature. So that the scent that appears is not the scent of brown. The unripe sapodilla fruit has not yet released an scent, while when it is ripe, it will emit a strong scent. In sapodilla, several compounds such as alcohol, phenols, alkanes, aldehydes, scentic compounds, secondary alcohols, scentic amino, and halogens will come out when the fruit is ripe (Orwa C, et al.,2009).

The scent of off-grade sapodilla jelly candy is influenced by the scent of gelatin because the concentration of gelatin given is quite large, namely 18% and 20%. According to Aris et al. (2020), gelatin is in sheets, pieces or pieces or coarse to fine powder,

weak yellow or light brown. The colour varies depending on the particle size. The solution smells weak like broth. If dry, stable in air, but easily decomposed by microbes if moist or in solution form.

d. Texture

The texture is one of the important characteristics of food products in influencing consumer acceptance. Table 3 shows the hedonic value of off-grade sapodilla jelly candy texture ranges from 3.933 to 4.132 (regular-like). This is because the treatment has a significant difference in texture. The resulting surface is almost different in each treatment because there is an influence from the concentration of gelatin or the concentration of salt solution during the sapodilla fruit soaking process.

The analysis results showed that the panellists favoured the high concentration of gelatin and the higher concentration of a salt solution. The higher the concentration of gelatin added to the off-grade sapodilla jelly candy, the hedonic quality value of the texture also increases. This is directly proportional to the surface of the jelly candy, which was tested using a texture analyzer, where the texture of the off-grade sapodilla jelly candy is almost close to that of commercial jelly candy. In addition, the higher the concentration of gelatin in a product will result in lower syneresis in a product (Mutlu et al., 2018), resulting in a gel with a higher gel consistency, and the jelly candy product obtained becomes chewy (not too hard) which the panellists preferred. According to Rahmi et al. (2012), if the gelatin concentration is too low, the gel will become soft, or even gel will not form. But if the concentration of gelatin is too high, the gel formed will be stiff.

e. Overall

Overall acceptance is the most important because it relates to the level of

endorsement of the product by the panellists. Table 3 shows that the overall hedonic value of off-grade sapodilla jelly candy ranges from 2.792 to 3.146 (rather unfavourable). The analysis of variance ANOVA showed that the four treatments were not significantly different at the 5% test level on the panellists' preference level. This indicates that the difference in treatment on off-grade sapodilla jelly candy does not affect the panellists' preference for overall acceptance. This shows that the treatment can be used because it has almost the same level of acceptance. Overall, found the highest value in off-grade sapodilla jelly candy with L3G1 treatment.

CONCLUSION

Following the study's objectives, the greater the concentration of salt given to the off-grade sapodilla sample, it showed that the salt was able to reduce the amount of tannin content. In jelly candy, the tannin content obtained is decreased compared to the tannin content of off-grade sapodilla fruit. This is due to the unstable or too high cooking temperature. Based on the results of the texture test, it found that the L2G2 treatment (4% salt solution, 20% gelatin) was closest to the commercial texture, while based on the organoleptic test, the L3G1 treatment (6% salt solution, 18% gelatin) had the highest value by the panellists.

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