The use of konjac flour as gelatine substitution in making *panna cotta*

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**Abstract.** The *panna cotta* is one of the Italian desserts served cold. The row materials for this dessert are cream and milk that are cooked with other ingredients such as sugar and gelatine. The characteristics of *panna cotta* resemble pudding, but the gel nature of this dessert is softer and can melt in the mouth when eaten. This study was purposive to determine the quality characteristics of *panna cotta* after the use of konjac flour (*Amorphophallus konjac*) as the substitution of gelatine. This research was conducted using a non factorial completely randomized design with 4 replications, with konjac substitution to gelatine were 100%, 75%, 50%, 25%, and 0%. Based on the tests carried out, it was found that the substitution of konjac flour to gelatine had a very significant effect on texture, vitamin C levels, and syneresis. The resulting *panna cotta* of texture ranges from 0.2751 mm/g to 0.2870 mm/g. The resulting *panna cotta* of vitamin C levels ranges from 8.3745 mg/100g to 11.5922 mg/100g. The resulting *panna cotta* of syneresis ranges from 6.4199% to 4.2715%. In addition, the substitution had no significant effect on the colour (*Hue*), pH value, and organoleptic (colour, flavour, taste, and texture).

1. **Introduction**  

*Panna cotta* is one of the Italian desserts served cold. The row materials for this dessert are cream and milk that are cooked with other ingredients such as sugar and gelatine. The characteristics of *panna cotta* resemble pudding, but the gel nature of this dessert is softer and can melt in the mouth when eaten and the thickener used is not starch or egg like pudding in general [1]. The thickener used in *panna cotta* is gelatine. Preparation of *panna cotta* in Italy generally uses whipped cream and milk in the same ratio (1:1). This comparison produces *panna cotta* quality with a soft texture, sweet and creamy taste. According to [1] states that the use of a ratio of whipped cream and milk (1:1) is changed to whipped cream and milk (1:9) produce a *panna cotta* formula that is suitable for the people of Indonesia, because generally Indonesian people do not like cream that is too thick. Then, the addition of gelatine in the process of making *panna cotta*, which is increasingly will result the decrease in a percentage of syneresis and *Hue* of *panna cotta*, but the redness and yellowness increase.

Gelatine is a colloid where macroscopically, colloids appear homogeneous, but microscopically colloids are heterogeneous [2]. Colloids also have the property that they dissolve in warm water and when put in a temperature below 30 °C, this colloid solution will form a gel with thixotropic and reversible properties, and will become liquid again when heated [3]. The most important physical property of gelatine quality is the value of gel strength, namely the ability of a gelatine to change from gel phase to sol or vice versa. Gel strength values based on Lapi Gelatine standards are 80 g - 300g
Bloom. Gelatine quality standards according to the Indonesian National Standard [4], namely: colourless, sometimes yellowish; smell, taste normal / consumer acceptable; maximum water content 16%; maximum ash content 3.25%; heavy metal maximum 50 mg/kg; arsenic maximum 2 mg/kg; copper maximum 30 mg/kg; zinc maximum 100 mg/kg; sulphite maximum 1000 mg/kg. The unique ability of gelatine is, gelatine can form a gel that is reversible in a heat that similar as human body temperature and dissolved in water. That is why it is necessary to replace gelatine as a thickener in making panna cotta so that it does not melt easily. Gelatine is a protein from bone and skin collagen hydrolysis that has been widely used for various industrial purposes with the aim of increasing the water binding capacity of processed meat products, purifying fruit juice products, and forming gels in candy products [5].

Konjac or konjac manan, originating from porang tubers (Amorphophallus konjac), is a hydrocolloid polysaccharide which is soluble in hot or cold water, has high viscosity with a pH between 4.0 and 7.0. The advantage of using Konjac is even if the pH is lowered to 3.3, the hydrocolloid will not settle. Therefore, konjac can function as a gelling agent, thickener, emulsifier, and stabilizer [6]. In addition, konjac is different from other hydrocolloids because it has a very high water absorption ability, which is able to absorb 100g of water per gram of sample. If the more konjac concentration is added, the more water will be absorbed so that the emulsion becomes unstable [7]. Based on that characteristics, it is possible to use konjac as a substitution for gelatine in a food. Konjac dissolves in hot or cold water, has high viscosity with a pH between 4.0 and 7.0 [6]. Based on the above properties, it is hoped that konjac can be used as a mixture to increase the elasticity of gelatine and can maintain the texture of panna cotta.

The purpose of this study was to determine whether the substitution of konjac flour to gelatine can affect the quality characteristics of panna cotta and whether konjac flour can replace gelatine as a gelling agent in making panna cotta.

2. Materials and methods

The preparation of panna cotta was done in the following steps: mixed 500 g full cream pasteurized milk, 55 g light whipping cream, and 25 g sugar. Previously, the gelatine and konjac flour used were pre-treated by hydrating the gelatine and konjac flour with 115 g of milk and leaving them for 15 minutes. The ratio of gelatine: konjac flour = 100%: 0%, 75%: 25%, 50%: 50%, 25%: 75%, and 0%: 100%, percent konjac flour 0%, 25%, 50%, 75%, and 100%, then put into the first mixture. Then, the mixture was heated to a temperature of 70 °C for 5 minutes. After that, the panna cotta dough was poured into a plastic cup and cooled to reach room temperature to prevent condensation on the cup lid during storage. Then, the panna cotta dough was cooled in the refrigerator at 5°C for 30 minutes.

This research was conducted in October 2019 until it was completed at the Food Chemical Analysis Laboratory and Food Technology Laboratory in the Department of Food Science and Technology, Faculty of Agriculture, Universitas Sumatera Utara, Medan. This research is using a non factorial completely randomized design with 4 replications. The ratio of gelatine: konjac flour = 100%: 0%, 75%: 25%, 50%: 50%, 25%: 75%, and 0%: 100%.

2.1. Research method’s

Observations and measurements of data were carried out for the physical, chemical and functional characteristics parameters, texture with the EIE penetrometer (typeTM-44C) [8], colour (“Hue”) with a Minolta chromameter (type CR 400, Japan) [9], vitamin C with using a solution Dye and the spectrophotometry method [10], Syneresis [11], pH with a pH meter [12], and organoleptic [13].

3. Results and discussion

The results showed that, the substitution of a konjac flour on gelatine had no significant effect for the observed parameters, namely the pH value, colour (“Hue”), and organoleptic (colour, flavour, taste, and texture) and had a very significant effect on the observed parameters, namely texture, syneresis, and vitamin C. That all test can be seen from the Table 1.
Table 1. The result of the test on texture, syneresis, vitamin C levels, colour, pH value, organoleptic (colour, flavour, taste, and texture)

| Parameters                  | Ratio of gelatine: konjac flour |
|-----------------------------|---------------------------------|
|                             | 100% : 0% | 25% : 50% | 50% : 50% | 25% : 75% | 0% : 100% |
| Colour (*hue*)              | 66.5977   | 69.1143   | 68.1185   | 68.1414   | 67.8566   |
| pH value                    | 6.3750    | 6.3838    | 6.4134    | 6.3352    | 6.4483    |
| Syneresis (%)               | 6.4199<sup>A</sup> | 5.9947<sup>B</sup>A | 6.0133<sup>b</sup>A | 4.7634<sup>c</sup>B | 4.2715<sup>d</sup>B |
| Organoleptic of colour      | 5.5298    | 5.5059    | 5.5167    | 5.5143    | 5.4905    |
| Organoleptic of flavour     | 5.4107    | 5.5083    | 5.4060    | 5.3929    | 5.3714    |
| Organoleptic of taste       | 5.6619    | 5.6262    | 5.6274    | 5.6238    | 5.5595    |
| Organoleptic of texture     | 5.2396    | 5.3607    | 5.3167    | 5.3690    | 5.3036    |
| Texture (mm/g)              | 0.2751<sup>d</sup>D | 0.2788<sup>c</sup>C | 0.2832<sup>b</sup>B | 0.2872<sup>a</sup>A | 0.2870<sup>a</sup>A |
| Vitamin C levels (mg/100g)  | 8.3745<sup>d</sup>D | 8.3832<sup>a</sup>BC | 9.0790<sup>c</sup>B | 11.1143<sup>b</sup>A | 11.5922<sup>a</sup>A |

Note: Different letter notations show a significantly different effect at the α = 5% level (lowercase letters) and very significant differences at the α = 1% level (uppercase letters)

3.1. Colour (*Hue*)
Substitution of gelatine with konjac up to 80% gave no significant effect on the colour of panna cotta. The resulting colour (*hue*) was ranged between 66°-68° which indicates a yellow red colour. This is consistent with previous research [1], which stated that an increase of gelatine concentration result in the increased in redness and yellowness of panna cotta. According to other study [14], the addition of konjac flour in the production of fleece gave the fruit use value on the fluenial colour (*Hue*) which was not significantly different. Thus, the colour (*hue*) obtained is only affected by gelatine.

3.2. pH value
The pH of panna cotta did not change on the substitution of konjac instead of gelatine. The pH ranged between 6.37 to 6.44. This is in accordance with [3] literature, which states that the pH of gelatine was 4.462. And according to [15], konjac has a normal pH value (close to 7) so that when it is mixed with acidic gelatine, it will increase the pH value of the product.

3.3. Syneresis
The substitution of konjac on gelatine gave a very significant effect on the syneresis. The syneresis values of the product as a result of konjac substitution against gelatine can be seen in Figure 1.

![Figure 1. Syneresis values of the product as a result of konjac substitution against gelatine](image-url)
The addition of more konjac caused the syneresis to be getting lower. Syneresis is defined as the process of releasing water from the cell because of shortening gel. The calculation of syneresis is done by measuring the weight loss of the sample during storage process and then, compared with the initial weight of the gel [16]. The addition of konjac in the gel was intended to increase the strength and elasticity of the gel, as well as reduce the level of syneresis [17] because konjac contains hydrocolloids, namely glucomannan which has a high water absorption ability [18]. As a result, the resulting syneresis value is lower because the concentration of added konjac to gelatine is higher so that more water will be absorbed. Previous research [1] showed that the syneresis of panna cotta with gelatine decline. This is because gelatine has the ability to trap water in the matrix structure [19]. The more gelatine concentration was added to the product will make the more matrix can trap water. So, the syneresis value will be more decreased.

3.4. Organoleptic (colour, flavour, taste, and texture)
The organoleptic (colour, flavour, taste and texture) result from the substitution of gelatine and konjac is 5, which indicates that the product is favoured by the panellists. This happens because konjac does not have a distinctive taste and flavour or has a neutral taste and flavour, has a white colour, and has a high viscosity value [6], so it does not affect the colour, flavour, taste and can improve the elasticity of the product. Other research [14] states that the concentration of konjac had no significant effect on physical, chemical and organoleptic properties of banana-red fruit leather.

3.5. Texture
The substitution of konjac on gelatine gave a very significant effect on the texture. The texture of the product as a result of konjac substitution against gelatine can be seen in Figure 2.

![Figure 2](image_url)

**Figure 2.** The texture of the product as a result of konjac substitution against gelatine

The diagram shows that, the texture of the product increased cause of the more konjac addition, meaning that the texture became harder. This happens because, that konjac contains glucomannan, which is a dietary fibre that has a larger cell size than other components [13] so it can affect the increase in texture. The result same with other study [20] which states that, the more concentration of konjac was added, will make the texture value getting higher. Konjac is a hydrocolloid which can act as a gelling agent so the more concentration was added, the texture quality of the product will be stronger.
3.6. Vitamin C levels

The substitution of konjac on gelatine gave a very significant effect on the level of vitamin C. The level of vitamin C values of the product as a result of konjac substitution against gelatine can be seen in Figure 3.

![Figure 3. The level of vitamin C values of the product as a result of konjac substitution against gelatine](image)

The result shows that, the more konjac substitution will make the increasing of vitamin C of the product. This increase might be caused by the composition of konjac which contains water-soluble fiber in the form of glucomannan, that has the ability to bind water. Soluble fibre content affects water absorption. Vitamin C from all ingredients that used to make this product will be absorbed by the konjac [21]. Based on research [22], it shows that the value of vitamin C levels obtained is higher. This happens because the higher concentration of a gelatine added will increase the value of the vitamin C content in the product.

4. Conclusions

Based on the research, it was found that the substitution of konjac in gelatine can increase texture, vitamin C, and decrease the syneresis of panna cotta. In addition, all panna cotta had similar colour (°Hue), pH value, and organoleptic, which mean that konjac can be used as a substitute for gelatine because it retains its shape and can improve the quality of panna cotta. A finding results may suggest the use of partial konjac as the substitution of gelatine in producing panna cotta.

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