Analysis of The Texture Profile and Sensory Quality of The Jelly with The Addition of Liquid Cork Fish (*Channa striata*)

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Abstract. Variations in the concentration of cork fish liquid in jelly were used in the investigation of the effect of cork fish liquid on the quality of jelly products. To establish the textural profile and level of preference of the panelists, the jelly was blended with the Cork fish juice. The different concentrations of Cork fish juice, such as K (0%), A (5%), B (10%), C (15%), and D (20%) v/v. After being mixed with Cork fish liquid according to the procedures, the jelly was packaged in plastic cups with a capacity of 50 ml each and refrigerated at a temperature of 10-15°C overnight. The purpose of this experiment was to see how cork fish juice affected the texture and sensory quality of jelly. The results reveal that panelists are willing to eat jelly mixed with Cork fish liquid, but that the more the concentration of Cork fish liquid added, the lower their preference level. Treatment A produced the best results among the cork fish liquid treatments, with a panelist preference value of 5.60, which was similar to syneresis 10.80, elasticity 0.83, cohesiveness 0.57, gumminess 419.50, elasticity 339.40, resilience 0.23, hardness 847.30, and gel strength values of 534.85 g/cm², respectively.

1. Introduction

Cork fish is a predatory fish that contains albumin, an essential and non-essential amino acid, as well as unsaturated and saturated fatty acids, anti-inflammatory and antibacterial characteristics, and can be used to treat a number of conditions [1] [2]. The presence of albumin and zinc in cork fish liquid extract is beneficial to one's health. Because of its high albumin content, cork fish are used to treat hypoalbuminemia. The amino acid concentration of liquid extracts is dominated by non-essential amino acids such alanine, aspartic acid, glycine, alloseloseine, proline, and glutamine, while essential amino acids like leucine, lysine, and phenylalanine are the most prevalent. In the presence of essential and non-essential amino acids, antihypertensive inhibitors (Angiotensin Converting Enzyme (ACE) with a strength of 1/10 that of the hypertension drug captopril) can be discovered [2]. The slight fishy smell causes not all consumers to like it, therefore masking is necessary. Masking techniques can be applied such as adding flavors that can disguise fishy odors or diversifying them by mixing them into pastries or snacks such as jelly.

Jelly products are made from a combination of carrageenan and konjac. The ratio of carrageenan and konjac affects the elasticity of the jelly product. The amount of carrageenan added to the jelly product affects its hardness value. The harder the jelly product, the higher the carrageenan content; otherwise, the extra konjac makes the jelly product more elastic. The synergy of carrageenan and konjac can create a variety of products such as mentioned by [3], [4] and [5]. Carrageenan and konjac
are both gelling agents, thickeners, emulsifiers, and stabilizers with similar physical properties. [6]. The main distinction is that carrageenan has a higher hardness than konjac, which has a higher viscosity. Carrageenan and konjac in the appropriate proportions provide flexibility that caters to customer preferences. The primary culinary hydrocolloids, carrageenan and konjac, are commonly utilized for textural functionality, particularly in dairy products, jellies and confectionary, and cooked processed meat products. Due to excluded volume effects that raised the effective concentration of the hydrocolloid and electrostatic interactions between both polymers in solution, combining carrageenan, konjac, and protein can improve gel hardness, cohesiveness, gumminess, springiness, and diminish synaeresis [7].

Carrageenan's capacity to interact with milk proteins is one of the most essential characteristics that distinguishes it from other hydrocolloids. The strong electrostatic contact between the negatively charged ester sulfate groups in the carrageenan molecule and the significant positive charges of the milk casein micella is responsible for the remarkable reactivity of carrageenan with protein. Another type of interaction is the formation of linkages between carrageenan's ester sulfate groups and the carboxylic residues of the amino acids that make up the protein. Many factors influence protein reactivity, including carrageenan concentration, protein type, temperature, pH, and the protein's isoelectric point. Carrageenan is an effective component for stabilizing and gelling milk products because of its capacity to compound with milk proteins and its water gelling characteristics. An anionic polysaccharide known as kappa-carrageenan was chosen as a thickening and gelling agent in bovine serum albumin [8]. The purpose of this study was to determine the texture profile and sensory quality of jelly with the addition of cork fish liquids.

2. Material and Method

2.1. Material
The raw materials used in the study consisted of live cork fish from Merauke district – Papua, with an average weight of 200 – 300 g / tail, while additional ingredients such as nutrijell and low-calorie sugar came from commercial products. For the equipment used consists of cork fish liquid extract machine, boiling container (stainless steel), thermometer, stirrer, sealer, glass plastic transparent and chilling room.

2.2. Methods
The process to producing jelly is divided into two stages: the first involves killing live cork fish by immersing them in ice water at a temperature of 10°C, and the second involves separating the meat from the skin in fillets. The separated meat from the cork fish is thoroughly cleansed before being minced in a meat grinder. In the extractor machine, the minced cork fish meat is heated to 70°C for 30 minutes. A spinner machine is used to extract the liquid that was leaked from the meat of the cork fish, which is then utilized as a treatment in the production of jelly.

The second stage involves weighing the nugrijell by 14 g, adding 1753 ml water, stirring until uniform, and heating to 90°C until all of the nutrijell was completely dissolved. After all, nutrijell dissolves perfectly, so add up to 234 g of low-calorie sugar. After all of the sugar was dissolved in the liquid nitrijell, reduce the temperature to 70°C and then add the cork fish liquid. K (0 %), A (5 %), B (10 %), C (15 %), and D (20 %) (v/v) cork fish extract liquid with a three-time repetition quantity, in line with the treatment given. Put the nutrijell liquid that was poured to the cork fish liquid into a transparent plastic glass that approximately 500 ml and close it while it is still hot. There are 40 packs in each treatment. Jelly that was chilled at ambient temperature before being stored overnight at 10 - 15°C. After that, sensory properties and textural profile test were performed on the jelly that was stored the night before. The textural profile test consists of gel strength, syneresis, springiness, cohesiveness, chewiness, and resilience was used A TA-XT2i texture analyzer (Stable Micro Systems, was used to compress gels between two parallel plates at a crosshead speed of 1 mm/s, and amino acids content by using HPLC.
3. Result and discussion

3.1. Characterization of liquid extract of Cork Fish

The cork fish extract liquid contains essential amino acids, non-essential, fatty acids consisting of saturated fat and unsaturated fatty acids. Table 1. The composition of amino acids and fatty acids. Amino acids from cork fish extract liquid can react with carrageenan, the properties of the gel that is formed depends on the concentration of amino acids that was added. The presence of fatty acids in cork fish extract liquid that reacts with carrageenan will be able to improve the gel structure of the jelly product. The results showed that concentration of fatty acids contributed to stretch and flow by providing a lubricating effect when melted [9].

| Composition         | Unit | Value   |
|---------------------|------|---------|
| Unsaturated fatty acids | %   | 0.62    |
| Saturated fatty acids  | %   | 0.42    |
| Prolin              | ppm  | 731.61  |
| Tyrosine            | ppm  | 672.67  |
| Arginin             | ppm  | 3,169.14|
| Alanin              | ppm  | 2,372.23|
| Aspartat            | ppm  | 4,132.68|
| Glutamate           | ppm  | 4,190.14|
| Siren               | ppm  | 731.61  |
| Glisin              | ppm  | 3,169.14|
| Isoleusin           | ppm  | 1,386.13|
| Leusin              | ppm  | 2,721.82|
| Phenilalanin        | ppm  | 2,291.83|
| Lisin               | ppm  | 4,883.68|
| Valin               | ppm  | 1,211.57|
| Histidin            | ppm  | 759.24  |
| Methionine          | ppm  | 594.03  |
| Threonin            | ppm  | 1,408.91|
| Albumin             | mg/g | 47.29   |

3.2. Sensory test

Parameters that were used to determine the quality of jelly was: appearance, smell, taste and texture. The assessment criteria were very like, like, neutral, slightly like, dislike and very dislike with the highest score of 7.

Appearances value all treatments between 5.15 – 6.11 ± 0.40 the lower were found on the treatment C was 5.11 ± 1.53 and the higher on the K was 6.11 ± 0.87. Based on the borderline that was determined, namely 5, it can be seen that all panelists received all treatments for adding Cork fish liquid to the product jelly. The jelly was packaged in a cylindrical plastic cup, with a white cloud jelly color. In this study, the standard deviation between treatments was 0.40, while each treatment ranged from 0.63 - 1.70 (Table 2). This means that there is a difference in perception between the panelists on the appearance of all treatments. Organoleptic value is a test that is based on the panelist's physio-psychological ability in exploiting their senses to determine the properties of objects caused by the stimulation received by the panelist's senses from the product they are facing. Or in other words, there
is a mental reaction if the senses are stimulated. The reaction or impression caused by the stimulus can be in the form of an attitude to approach or stay away, like or dislike the stimulus provided by the product [10]. Awareness, impressions and attitudes to stimuli are psychological reactions or subjective reactions to the assessment of a product. If the stimulus provided by the product appeals to the panelists' senses, the subjective value in the form of numbers is given higher and vice versa. The difference in the standard deviation of each treatment that was carried out shows that the stimuli given with each treatment are different received by the panelists.

Smell value of a jelly product was found between 5.700 - 5.90 ± 0.50, the lower value of treatment K 4.80 ± 1.42 and the higher treatment A was 5.90 ± 0.57 and C 5.90 ± 0.67. The C and D treatments have the same value (5.90) but differ in the standard deviation. The difference in the perception of stimuli from Cork fish liquid jelly was caused different standard deviation values for each treatment. The results of the smell assessment, it turns out that the panelists prefer jelly that was given Cork fish liquid compared to the K. The presence of a specific preference for Cork fish liquid mixed with jelly (a combination of carrageenan and konjac) in the jelly product was attracted the attention of the panelists so that the panelists' sense of smell gave a higher value to all treatments with the addition of Cork fish liquid compared to K. Another possibility was that the combination of amino acids and fatty acids in the Cork fish liquid mixed with the smell of a mixture of carrageenan and konjac were created a smell that was acceptable to the panelists.

Taste value of jelly production in range of 4.70 - 6.40 ± 0.70, the highest taste close to the agreed value of 7 found in the K was 6.40 ± 0.69, while the lowest value was found in the D treatment in 4.80 ± 1.64. The combination of the sweet taste and smell of Cork fish liquid in the treatment was created a taste that wasn’t acceptable by the panelists. The highest concentration of Cork fish liquid was added to the jelly liquid (a combination of carrageenan, konjac and sugar), the higher the panelists' rejection of the taste of the treatment jelly. The value given by the panelists for each treatment, especially jelly that was added to Cork fish liquid, was a high standard deviation value compared to the K. This shows that the opinion amongst the panelists in assessing the jelly that was added to Cork fish liquid wasn’t uniform.

Table 2. Preference test of jelly product that content liquid of Cork fish

| Code of sample | Appearance | Smell | Taste | Texture | Acceptance value |
|---------------|-----------|-------|-------|---------|-----------------|
| K             | 6.11±0.87 | 5.70±1.42 | 6.40±0.69 | 6.10±0.74 | 6.10±0.36 |
| A             | 5.70±0.67 | 5.90±0.57 | 5.20±1.23 | 6.00±0.67 | 5.70±0.57 |
| B             | 5.75±0.63 | 5.80±0.80 | 4.90±1.10 | 6.10±0.74 | 5.60±0.56 |
| C             | 5.15±1.53 | 5.90±0.67 | 5.10±1.29 | 6.10±0.74 | 5.60±0.56 |
| D             | 5.30±1.70 | 4.80±1.23 | 4.70±1.64 | 6.00±0.71 | 5.20±0.52 |

Note: K (0% liquid extract from cork fish); A (5% liquid extract from cork fish); B (10% liquid extract from cork fish); C (15% liquid extract from cork fish) and D (20% liquid extract from cork fish).

Texture value of jelly production in range of 6.00 - 6.10±0.10, the lowest value in treatments A and B was 6.00 with different standard deviation values (Table 2). The difference in standard deviation was due to the response of the panelists to each other differently in accepting the jelly texture that was added with liquid of Cork fish. On the treatment K, B and C the same value of texture was 6.10±0.74. Based on the standard deviation, the three treatments had the same standard deviation value of 0.74, which means that all panelists' perceptions of the product jelly had the same response. The addition of Cork fish liquid 10-15% did not affect the texture, but the addition of 5% and 10% decreased the texture value compared to the K. Proteins and polysaccharides are present together in many food systems, and both types of food macromolecules contribute to their structure, texture and stability. The functional and processing properties of food products are determined by the interactions between
proteins and polysaccharides [11] in [12]. The addition of 5% Cork fish liquid containing amino acids and fatty acids into the jelly product was a lower texture value compared to the K. It is possible that the addition of 5% was not achieved the balance of the reaction between amino acids and polysaccharides (a mixture of kappa carrageenan and Gucomannan) so that the appearance of the texture was not favored by the panelists, while the addition of 20% of Cork fish liquid was also less favorable. The addition of high protein may cause synergies so that the appearance of the jelly becomes less attractive.

Based on the average value of appearance, smell, taste and texture, the best treatment among the treatment of adding Cork fish liquid was the A treatment of 5. 70 ± 3.5, treatment B and C the same value was 5. 60 ± 0. 56, the D treatment was the lowest value among the treatment with the addition of Cork fish liquid (Table 2).

The statistical analysis test found the value degradation preference of panelists was linear regression: Y = - 0.1904x + 6.2078; r² = 0.9149. It means that increase concentration of Cork fish liquid in the jelly was affected the panelists' preference. The main cause is the fishy smell that is getting stronger. It is known that Cork fish is a predatory fish that live in muddy swamps. The high fishy smell is caused by the Cork fish having a high protein content, especially derived from ammonia, trimethylamine, acid volatile fats and results from fatty acid oxidation [13].

3.3. Texture Profile Analysis
The parameters used to assess the quality of the jelly that was added to Cork fish liquid were syneresis, gel strength, springiness, cohesiveness, gumminess, chewiness, resilience, and hardness.

Syneresis occurs due to water precipitation from the filler (carrageenan, konjac and water-soluble protein). The amount of water that leaching out of the jelly was influenced by the ratio of carrageenan, glucomannan, protein and the amount of minerals in the jelly solution. In this study, the ratio of carrageenan and Gucomannan was made the same, the difference was the concentration of Cork fish liquid added. The syneresis values of all treatments such as in Tabel 3. The amount of Cork fish liquid added to the jelly product causes the synergistic value to change. The results of linear regression calculations obtained the equation: y = 0.16x + 10.3 r² = 0.9143 which means that the addition of Cork fish liquid was causing the synergetic value to increase. Increased syneresis occurs because the protein undergoes denaturation which results in some of the water being precipitated out of the product jelly [14]. On the Tabel 2 showed that the syneresis in the range of 10.4 – 12. 00% ± 0. 6, the highest syneresis was found on the K 12. 00% ± 2. 181 and the lowest was at 10. 40 ± 2. 33 (Table 2). The highest syneresis between treatments with the addition of Cork fish liquid was found in the D treatment, then the lowest was found in the A treatment. Based on the research, it turns out that the increase in the concentration of Cork fish liquid in the jelly product results in an increase in syneresis. Proteins and polysaccharides are present together in many food systems, and both types of food macromolecules contribute to their structure, texture and stability. The functional and processing properties of food products are determined by the interactions between proteins and polysaccharides [12]. Furthermore, [14] said that the interaction of polysaccharides and proteins has an effect on increasing syneresis, hardness, gumminess, cohesiveness, springiness and decreasing simerises. The lowest syneresis found during the study between treatments of Cork fish liquid concentration was found in the A treatment.

Springiness or elasticity can be defined as the recovery time between the end of the first chew and the beginning of the second chew and units are used because of this parameter to calculate the difference time area [15]. On the Table 3 range of 0.51 - 0. 83 ± 0. 12, the lowest value of springiness was found in the K treatment of 0. 51 ± 0. 10 and the highest in the C was 0. 83 ± 0. 19. In treatment K, the value of springiness was more influenced by the combination of carrageenan and konjac while in treatments A, B, C and D there was variation in the value of springiness with a maximum value of 0. 83 ± 0. 19 found in treatment C (15% addition of Cork fish liquid), addition of Cork fish liquid more than 15% such as C treatment there was a decrease in springiness. The highest value of the springiness level was found in the C treatment and then followed by D treatment, B, K and the lowest
A treatment. The difference in the level of springiness was caused by the concentration of protein, minerals and fatty acids in the added Cork fish filtrate. The increase in springiness value was not parallel with the addition of Cork fish filtrate into the liquid combination of carrageenan and konjac. The value of springiness A treatments lower than K treatment (without adding Cork fish liquid). However, the addition of Cork fish liquid up to 15% was increased the value of springiness. The optimum addition of 15% Cork fish liquid (C treatment) was the best result compared to other treatments. It was suspected that the combined concentration of carrageenan and konjac with the Cork fish liquid was reached the optimum value of springiness (Table 2). [16] Reported that blending hydrocolloids with protein can effectively improve physicochemical and functional properties of proteins. As thickening and water-holding agents, hydrocolloids influence the structure, texture, including hardness, gumminess, chewiness, springiness, cohesiveness and resilience of food products by covalent or non-covalent bonds with protein. The effects of food gums depend on the polysaccharide nature and concentration. Carrageenan is a linear sulfated polysaccharide extracted.

Cohesiveness is defined as the ratio of pressure area during second compression until the first compression where the material disintegrates mechanically with the secondary parameters of cohesiveness such as brittleness, chewiness and gumminess without units [15]. On the Table 3 was found the cohesiveness value in the range of 0.58 – 0.77 ± 0.09, the lowest on the treatment D was 0.58 ± 0.04 and the highest was found in treatments K and B of 0.77, which differed only the standard deviation. The highest standard deviation value in treatment B was 0.05. The difference in the standard deviation value is probably due to some of the proteins in treatment by having been denatured and resulting in deviations from the first and second compression pressures. The hardness, springiness and cohesiveness are the main parameter used to identify characteristics of smoked sausage texture [15]. The addition of proteins had a large effect on the texture and visual characteristics of the gels. The mixed gels showed increased gel turbidity and decreased syneresis [14].

Gumminess is the amount of force or energy required to break down semi-solid food so that it can be swallowed. The tool used to measure gumminess is texture analysis with the unit N (newton). The results of the gumminess analysis ranged from 236.10 – 419.55 N ± 67.76. Based on the standard deviation, it can be seen that the gumminess value varies greatly. The highest value of gumminess was found in treatment C (419.55 N ± 95.57) and the lowest in treatment K (236.10 N ± 24.51). The increase in the amount of Cork fish liquid in the jelly affects the gumminess value. The maximum addition of Cork fish liquid into the jelly is 15% (treatment C), but the addition of Cork fish liquid of more than 15% (treatment C) was causing the gumminess value to decrease. It is suspected that the excess amount of water soluble protein was decreased the gumminess value due to the reaction of the protein with the combination of carrageenan and glucomannan to form a brittle gel. The addition of proteins had a large effect on the texture and visual characteristics of the gels.

Chewiness is defined as the result gumminess value calculation multiplied by springiness value. Chewiness is the most characteristic of the texture, difficult to measure precisely, because involves compressing, shearing, piercing, simultaneous grinding, tearing and cutting with lubrication by saliva at a temperature of certain body [15]. On the Table 3 shows that the value of chewiness in the range of 150.60 – 339.40 ± 79.76, with the lowest value in treatment K 150 ± 3.65 and the highest value in treatment C 339.40± 2.10. Addition of Cork fish liquid can increase the chewiness value of the jelly product. The increase in chewiness value reached a maximum at 15% Cork fish liquid concentration, more than 15% addition of Cork fish liquid to jelly liquid was causing a decrease in chewiness value.

Resilience is a measurement of quantity, sample deformation recovery rate is seen in terms of speed and power. The resilience value is obtained from the comparison between the area before the peak and the area after the peak in the first compression. Resilience describes the product's ability to return to its original position immediately after experiencing the first compression before the second compression occurs. Resilience values for all treatments ranged from 0.27 to 0.47 ± 0.01, the highest value was 0.47 ± 0.05 in treatment A and the lowest was 0.23 ± 0.08 in treatment C. Giving Cork fish liquid as much as 5% (treatment A) can increase the resilience value, but giving Cork liquid greater than 5% was decreased the resilience value of the jelly product. Carrageenan is reactive to proteins which can
cause an increase in the hardness value of the jelly product. Increasing the hardness value will result in the product becoming hard and easy to rupture. The lower the resilience value, the jelly product will break easily.

The hardness value is the amount of force required to reach the peak during the first and second compressions. At the time of the first compression a hardness value of cycle 1 was obtained, while at the time of the second compression a hardness value of cycle 2 was obtained. The Hardness value describes the hardness of the resulting product. According to [17], measurement of product hardness can be carried out using standard compression forces within a certain time to determine the deformation that occurs in the product. Besides that, the hardness determination can also be used to determine a certain compression distance and measuring the force required to achieve the desired percent deformation [17]. The results of the study found that the hardness value was between 330 – 847. 30 ± 173.67, the lowest value was in treatment K and the highest was in treatment C. 15% addition of Cork fish liquid in jelly liquid, of 847. 30 ± 2.31, the lowest was in treatment K 330. 90 ± 0.26. It was suspected that the high jelly treatment added to Cork fish liquid compared to treatment K was due to the protein and fatty acid content in the Cork fish liquid. The increase of Cork fish liquid in jelly products caused the hardness value to increase, however, the addition of up to 15% Cork fish liquid was the highest result. The addition of more than 15% such as treatment D (20% Cork fish liquid added in jelly liquid) has caused a decrease in the hardness value (Table 3).

Table 3. Physical analyses Cork fish jelly

| Treatment | Syneresis (%) | Springiness | Cohesiveness | Gumminess | Chewiness | Resilience | Hardness | gelstrength (g/cm²) |
|-----------|--------------|-------------|--------------|-----------|-----------|------------|----------|-------------------|
| K         | 12.00 ±2.28  | 0.58 ±0.04  | 0.77 ±0.01   | 236.10 ±24.51 | 150.60 ±3.65 | 0.46 ±0.01 | 330.90 ±0.26 | 302.02 ±4.49     |
| A         | 10.40 ±2.33  | 0.51 ±0.10  | 0.77 ±0.05   | 279.50 ±25.67 | 189.20 ±6.03 | 0.47 ±0.05 | 452.30 ±0.29 | 391.97 ±27.88     |
| B         | 10.70 ±0.78  | 0.71 ±0.11  | 0.67 ±0.05   | 344.30 ±73.89 | 312.30 ±2.12 | 0.35 ±0.04 | 623.00 ±0.94 | 401.62 ±20.46     |
| C         | 10.80 ±0.88  | 0.83 ±0.19  | 0.57 ±0.23   | 419.50 ±95.57 | 339.40 ±2.10 | 0.23 ±0.08 | 847.30 ±2.31 | 534.85 ±6.89      |
| D         | 10.90 ±1.00  | 0.79 ±0.10  | 0.58 ±0.04   | 345.25 ±224.00 | 252.30 ±1.10 | 0.27 ±0.04 | 581.67 ±5.26 | 527.85 ±54.76     |

Note: K (0% liquid extract from cork fish); A (5% liquid extract from cork fish); B (10% liquid extract from cork fish); C (15% liquid extract from cork fish) and D (20% liquid extract from cork fish)

On the Table 3 showed that the gel strength value jelly production in the range of 302 – 534±88. 52 g/cm² with the highest value in treatment C of 534. 85±6. 89 g/cm² then D = 527. 85±54. 76, B= 401. 62±20. 46, A= 391. 97±27. 88 and K = 302. 02±4. 49 g/cm². It is known that cork fish extract contains water-soluble proteins that can interact with carrageenan. Carrageenan reacts positively with proteins to form cross-links. The formation of cross-links were highly dependent on the ratio between carrageenan gel and concentration of protein that was added. In this experiment, the highest gel strength value was found in treatment C. This may be due to treatment C, a balance was reached between added protein and available carrageenan in the jelly product, while the excess protein in the treatment D caused the gel strength value to decrease (Table 3).

4. Conclusion
Cork fish liquid can be added to improve the quality of jelly products. The addition of Cork fish liquid that was too high cannot be accepted by the panelists. Based on the organoleptic test and physical test, treatment A was the best after K (control) treatment. The panelists gave an organoleptic value of 5.60 which is equivalent synaeresis 10.80, springiness 0.83, cohesiveness 0.57, gumminess 419.50, chewiness 339.40, resilience 0.23, hardness 847.30 and gel strength value of 534.85 g/cm².

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