Effect Of Carrageenan For Making Concentrate Dispersion From Snakehead Fish (*Channa Striata*)

Meta Mahendradatta, Arfina Sukmawati Arifin, Zainal, Abu Bakar Tawali, Nandi K. Sukendar

Abstract: Preparation of concentrate dispersion from snakehead fish (*Channa striata*) as food supplement required stabilizer such as carrageenan. Snakehead fish was selected as raw material due to its high content of albumin protein. This research aimed to study the effect of carrageenan on physical stability of concentrate dispersion and to determine the optimal concentration of carrageenan which produced stable concentrate dispersion. Treatments used in this research were the concentration of carrageenan (0.5%, 1%, 1.5%, and 2%) and storage time (one day, three days and five days). Production process of concentrate dispersion from snakehead fish consisted of preparation of 10% fish concentrate solution, mixing with appropriate carrageenan concentration, homogenization at 6500 rpm for 5 minutes and sterilization at temperature 121^{o}C and 1 atmosphere pressure for 15 minutes. Observation was conducted on the stability of concentrate dispersion after one, three and five days. Measurement parameters were viscosity, sedimentation volume, phase separation, and redispersibility. The result showed that the difference of carrageenan concentration influenced the physical properties of concentrate dispersion. The higher the concentration, the greater the viscosity of carrageenan (61.33 - 1920.68 cP), the higher sedimentation volume (0.67 - 0.99 cm), the lower the phase separation (0.43 –0.01cm), and the lower redispersibility (13.55 – 0.33). The best concentration of carrageenan for making concentrate dispersion was 1.5%.

Key words: Albumin, Carrageenan, Concentrate dispersion, Snakehead fish.

1 INTRODUCTION

Indonesia is rich on bio-resources which should be fully utilized. Humans as living beings need these resources to meet the metabolic demands of life. Fish is one of the materials that are needed by humans because of the content of nutrients such as protein, minerals, vitamins, and other. One of the types of fish that are found in all the waters of Indonesia is snakehead fish. In Indonesia, snakehead fish whivh is known by various names such as Haruan fish, fish curse, Kanjilo, comes from a family Channidae or Ophiocephalidae with the scientific name *Channa striata* (Pillay and Kutty, 2005) or in some literatures is called also by the scientific name *Ophiocephalus striatus* (Bijaksana, 2004). Snakehead fish meat contains 70% protein and 21% albumin. Besides that, it also contains complete amino acid, as well as micronutrients zinc, selenium, and iron. Other content of snakehead fish meat is allisin, allyl sulfides, and furostanol glycoside. Snakehead fish included one of the biological resources that have high economic value because of high content of albumin (Mustafa, 2012; Sulistiyati, 2010). High content of protein particularly albumin in snakehead fish can increase endurance, so well taken by patients suffering from burns, post-operative patients, people who are recovering, old people who begin to experience decreased organ function, as well as children who are malnourished (Tawali et al., 2012).

- *Meta Mahendradatta, Lecturer at Food Science and Technology Study Program, Hasanuddin University, +6281342617892,*
  E-mail: meta_mahendradatta@yahoo.com
- *Meta Mahendradatta, Arfina Sukmawati Arifin, Zainal, Abu Bakar Tawali, Nandi K. Sukendar, Food Science and Technology Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia*

Snakehead fish has been processed into concentrate in form of capsule that has been shown to increase levels of albumin in patients and accelerate the healing of burns and post-operative recovery and was able to improve the nutritional status of the patient and the patient endurance of stroke, patients living with HIV, patients with tuberculosis (Tawali et al., 2012). Concentrated snakehead fish has a weakness due to its fishy smell, so it is not preferred by some people. Therefore, it is necessary to make product as food supplement from concentrated snakehead fish that can attract consumers. Fish protein concentrate is almost the same with fish meal, but it is not for human consumption purposes, only as animal feed (Windsor, 2001). In this research, concentrated snakehead fish was processed into liquid dispersion. Liquid dispersion is widely used because of ease of use on children, infants, and adults who are difficult to swallow tablets or capsules. The stability of dispersion is influenced by the use of stabilizer and the processing method. Stabilizer added is expected to provide a stable physical appearance. Based on this reason, the research aims to study the effect of the concentration of carrageenan as a stabilizer in the concentrate dispersion from snakehead fish and to determine the optimal concentration of carrageenan were added in order to produce stable concentrate dispersion.

2. MATERIALS AND METHODS

2.1. Equipment and Materials

The materials used in this study were snakehead fish, snakehead fish concentrate, carrageenan, cooking water. The equipments used in this study were analytical balance, homogenizer, stirrer rod, plastic containers, thermometers, Brookfield DV-E viscometer, and glass tools.

2.2 Research Design

The design of this research used Completely Randomized Design (CRD) consisting of two factors, namely: Factor A: addition of carrageenan with concentration of

A1 = 0.5%, A2 = 1%, A3 = 1.5% and A4 = 2%
Factor B: storage time
B1 = 1 day, B2 = 3 days and B3 = 5 days

2.3 Sampel Analysis

Parameters analyzed in this research were viscosity, sedimentation volume, phase separation, and redispersibility.

Viscosity (Febrina, 2007). Viscosity measurements performed using Brookfield DV-E viscometer with spindle speed slide and the corresponding number then the result was multiplied by a reading factor. A sample of 75 ml was added to the beaker glass and the viscosity was measured with a viscometer. The speed was set to 100 rpm then the spindle No. 5 was determined. Recorded results were then multiplied by a correction factor and expressed in unit cP or centipoises.

Sedimentation Volume (Voight, 1994). Sample of 100 ml (H0) was put in a glass bottle. The sedimentation volume (Vu) was measured after day 1, 3, and 5 then recorded in units of ml. The sedimentation volume (Vu) was compared to initial dispersion volume (Vo) on days one, three and five.

Phase Separation Ratio (Febrina, 2007). The samples were put into 60 ml glass bottle. The initial dispersion (H0) was measured and recorded in units of cm. Then the high water phase (H1) after day 1, 3 and 5, was measured and recorded in units of cm. The high-water phase (H1) was compared with high initial dispersion (H0) on day 1, 3 and 5.

Redispersibility (Febrina, 2007). The samples were put into 60 ml glass bottle. Agitation was conducted for each sample after 1, 3 and 5 days storage. It was calculated the amount of agitation required until the sample was dispersed back. The amount of shaking each sample was noted.

2.4 Data Processing

The experimental design in this study was completely randomized design (CRD) with 2 replications. Analysis of the data was tested by analysis of variance and if there was a real difference followed by Duncan's test (Gasperz, 1994).

3 Results and Discussion

Viscosity

Viscosity is one of the characteristics that indicate a product is thick or viscous. Viscosity can also be interpreted as the nature of the fluid that has friction or barriers when the fluid is moving. In liquid, the viscosity is caused by the presence of the cohesive forces between molecules. The higher the value, the more viscous is the product. The results of this study indicated that the addition of 0.5% carrageenan had the lowest viscosity of 61.33 cP, whereas the addition of 2% carrageenan had the highest viscosity of 1920.67 cP. The interaction between addition of carrageenan and storage time showed that the addition of carrageenan at viscosity of 0.5% on day 5 has the lowest viscosity of 60.00 cP whereas the addition of 2% carrageenan on day 1 has the highest viscosity of 1938 cP.

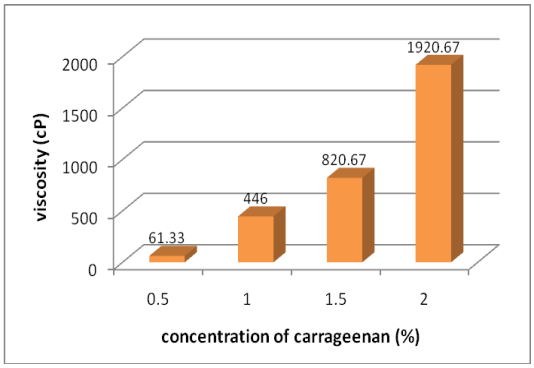

Figure 1. *Viscosity at various carrageenan concentration*

Results of analysis of variance on the viscosity of concentrate dispersion showed that the addition of carrageenan has very significant effect on the results of viscosity ($p>0.01$), so that the test followed by Duncan's Advanced methods. Duncan's test results indicated that the treatment method by addition of each concentration of carrageenan showed significantly different. This happens because carrageenan is a hydrocolloid type hydrophilic which can increase the viscosity so commonly used as a thickener, emulsifier, and stabilizer (Belitz et al., 2009). Figure 2 showed that viscosity obtained during storage was not significantly decreased ($p<0.05$). This is expected because the product of concentrate dispersion from snakehead fish may not change during storage significantly. Decrease in viscosity during storage is due to the activity of microbes that are able to decipher the glycosidic bond carrageenan polysaccharides classified as a natural stabilizer that is more easily broken down by microbes, thus causing its viscosity decreases. This is in accordance with Nep et al., (2011) which states that the suspension material derived from the class of polysaccharides when stored over a long period of time caused by the presence of microbial growth.

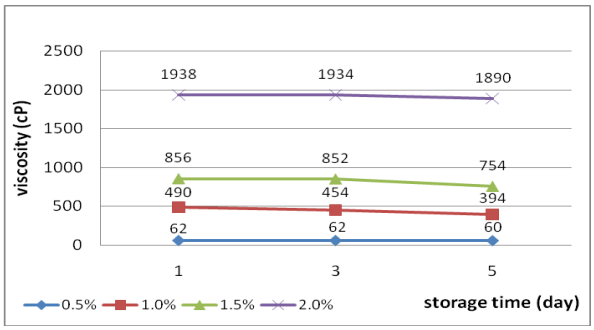

Figure 2. *Viscosity of various carrageenan concentrations during storage*

Viscosity at each treatment by addition of carrageenan during storage had no significant difference. The increase of carrageenan concentration on concentrate dispersion had a real effect on viscosity, but the decrease did not show significant difference during storage so it had no real effect. It was expected for a product that did not change significantly during storage. This is due to the nature of carrageenan that can be used as stabilizer in food products. This is in accordance with Belitz et al. (2009) which states that carrageenan can act in the food industry as thickeners, emulsifiers and stabilizers.

Sedimentation Volume

Sedimentation volume is one assessment of the dispersion stability. The higher sedimentation volume, the better the product is because it can be uniformly dispersed in medium. The results showed that the addition of carrageenan can increase the volume of sediment that was 0.57 to 0.99. Lowest sedimentation volume was obtained at 0.5% carrageenan treatment, and the highest volume of sediment derived from the treatment of the addition of 2% carrageenan as shown in Figure 3. The results of analysis of variance on sedimentation volume of concentrate dispersion indicated that the addition of carrageenan had very significant effect on the results of sedimentation volume ($p>0.01$), so the test method was followed by Duncan. Duncan's test results indicated that the treatment method of addition of 0.5% carrageenan had significantly different with the addition of 1%, 1.5%, and 2% carrageenan, respectively, but the addition of 1.5% carrageenan was not significantly different with the addition of 2% carrageenan ($p<0.05$).

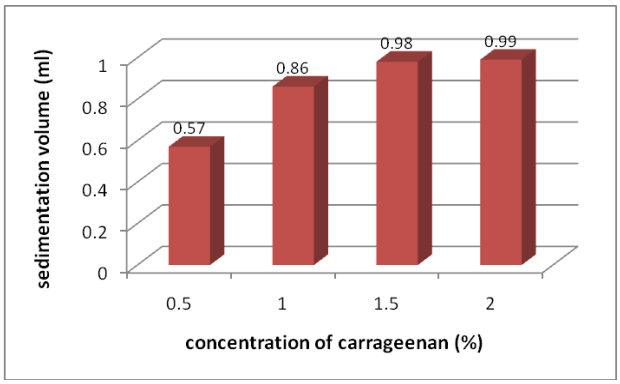

Figure 3. *Sedimentation volume at various carrageenan concentration*

Sedimentation volume is influenced by viscosity. High viscosity will lead to decrease in the force of gravity so that the sedimentation velocity will decrease and form a little sedimentation. The higher the viscosity, the sedimentation velocity will decrease so less sediment that forms. Vice versa, the lower the viscosity, the sedimentation velocity increases therefore more sediment or precipitate that forms and the volume of sedimentation is higher. The observation on sedimentation volume during storage time showed a decrease during storage. Lowest sedimentation volume at day 5 was obtained 0.54 ml at 0.5% carrageenan concentration and the highest was 0.98 ml as shown in Figure 4. Results of analysis of variance showed that the storage time of the sedimentation volume was highly significant ($p>0.01$), so further testing is done by the method of Duncan. Based on further Duncan test, sedimentation volume was not significantly different from day 1 to day 3, but significantly different with day 5. This suggested that the stability of the dispersion will decrease on day 5 because the viscosity decreased during storage.

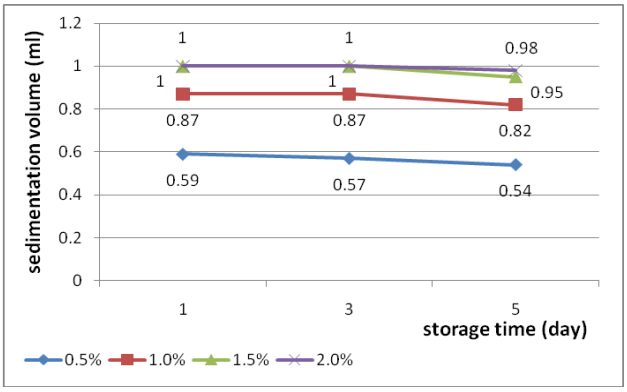

Figure 4. *Sedimentation volume at various carrageenan concentrations during storage*

The observation on the addition of carrageenan and storage time to sedimentation volume showed that treatment with the addition of 0.5% carrageenan has the lowest sedimentation volume than the addition of carrageenan at 1, 1.5, and 2% and tended to decrease during storage. Lowest sedimentation volume was obtained at 0.5% of carrageenan and the highest sedimentation volume was obtained on treatment of the addition at 2% of carrageenan. However, the addition of carrageenan 1.5% and 2% were not significantly different on day 1 and 3 ($p<0.05$).

Phase Separation

Phase separation is the high ratio of the dispersed substance (precipitate) to the original height before precipitation occurs. Phase separation is one of the assessments of dispersion stability. The lower the phase separation, the better is the product because it can be uniformly dispersed in the dispersing medium. The results showed that the addition of carrageenan can decrease the phase separation. Lowest phase separation was obtained at addition of 2% carrageenan and the highest phase separation was obtained at the addition of 0.5% carrageenan as shown in Figure 5.

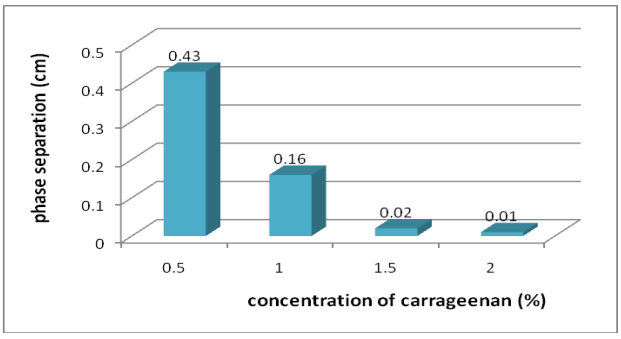

Figure 5. *Phase separation at various carrageenan concentrations*

Results of analysis of variance showed that the addition of carrageenan had very significant effect on the results of phase separation ($p>0.01$), so that the test followed by Duncan's methods. Duncan's test results further indicated that the treatment method of the addition of 0.5% carrageenan was significantly different with the addition of 1%, 1.5%, and 2% of carrageenan, but the addition of 1.5% was not significantly different with the addition of 2 % ($p<0.05$). Phase separation

was strongly influenced by the viscosity of product. High viscosity can decrease the phase separation due to gravitational force decreases, so that the deposition rate becomes slow. This is in accordance with Voight (1994) which states that the rate of deposition can be greatly reduced through increased viscosity of dispersing material.

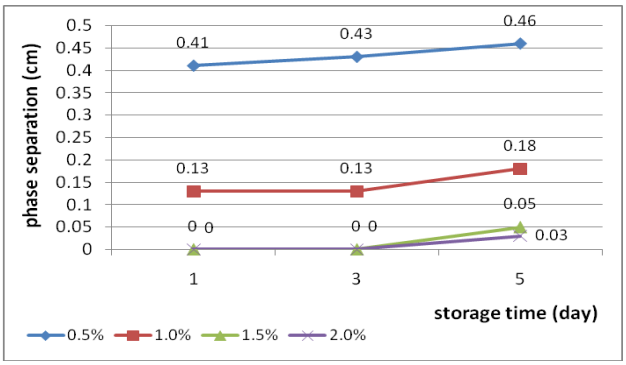

Figure 6. *Phase separation at various carrageenan concentrations during storage*

The observation on the phase separation showed a decrease during storage. Lowest phase separation was obtained on day 1 and the highest on day 5 is 0.18 as shown in Figure 6. Results of analysis of variance showed that the storage time had real effect, so the further Duncan's test was conducted. Duncan's test results showed that the treatment of day 1 was not significantly different to the treatment day 3, but significantly different to the treatment of day 5. Viscosity decrease led to accelerated sedimentation due to the greater gravitational force. The interaction between addition of carrageenan and storage time on phase separation showed that the treatment of addition of 2% carrageenan had the lowest phase separation compared to the treatment of addition of 0.5%, 1%, and 1.5% carrageenan. And there tended to be an increase during storage. Lowest phase separation was obtained by addition of 1.5% and 2% carrageenan at day 1 and day 3 and the highest phase separation was obtained by addition of carrageenan treatment 5 days of 0.5%. Results of analysis of variance showed that there was interaction between addition of carrageenan and storage time. Therefore the method of Duncan's test was conducted. The result indicated that the treatment method the addition of 0.5% carrageenan significantly different from day 1 to day 3 and day 5 ($p>0.01$) but, day 3 and day 5 was not significantly different ($p<0.05$). The higher the concentration of carrageenan was added, the higher was the resulting viscosity. High viscosity will reduce the speed of phase separation.

Redispersibility

Redispersibility was used to determine the amount of shaking which needed to homogenize product. The results of observation indicated that the addition of carrageenan may decrease redispersibility from 13.5 to 0.33. Lowest redispersibility was obtained by the treatment of the addition of 2% carrageenan and the highest redispersibility was obtained by the addition of 0.5% carrageenan (Figure 7).

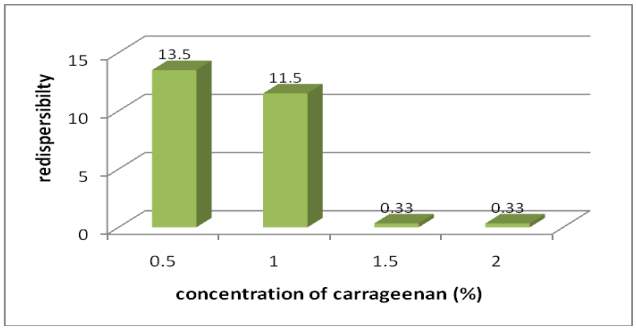

Figure 7. *Redispersibility at various carrageenan concentrations*

Results of analysis of variance showed that the addition of carrageenan had very significant effect on the results of redispersibility ($p>0.01$), therefore it was continued by Duncan's methods. Duncan's test results indicated that treatment of the addition of 0.5% carrageenan was significantly different with the addition of 1%, 1.5%, and 2% carrageenan, but the addition of 1.5% carrageenan was not significantly different with the addition of 2% carrageenan ($p<0.05$). The addition of 1.5% carrageenan was not significantly different with the addition of 2% carrageenan. This indicated that the addition of 1.5% carrageenan had similarity with the addition of 2% carrageenan because the volume of sedimentation and phase separation that occurred tended to be the same formula. Deposition can be reduced by increasing the viscosity so that the force of gravity becomes slow. One way to increase the viscosity is the addition of carrageenan. Because it is hydrophilic, the addition of carrageenan in a product will increase the viscosity. Redispersibility of various carrageenan concentrations during storage can be seen at Figure 8. Results of analysis of variance showed that storage time had no significant effect on redispersibility ($p<0.05$), therefore further study was not conducted.

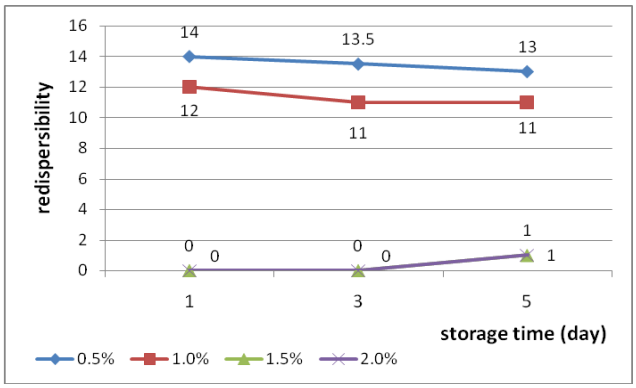

Figure 8. *Redispersibilty at various carrageenan concentrations during storage*

It was expected that the product maintained in a stable dispersion during storage. Redispersibility closely related to the dispersed phase. It was done to homogenize the dispersion if there were deposits. Viscosity influenced the redispersibility because the high viscosity will reduce the occurrence of precipitation. The observation on the interaction of addition of carrageenan and storage time showed that treatment with the addition of 0.5% carrageenan had the

higher redispersibility than the addition of carrageenan 1%, 1.5%, and 2%, and it tended to change during storage increase, but not significantly. Results of analysis of variance showed that the interaction between the addition of carrageenan and storage time had no significant effect on redispersibility ($p<0.05$).

CONCLUSION

It has been concluded that:

1. The greater the concentration of carrageenan added to snakehead fish concentrate dispersion, the higher the viscosity, the greater the sedimentation volume, the lower the phase separation, and the more quickly dispersed.
2. There was a decrease of viscosity, sedimentation volume, and redispersibility during storage while phase separation increased. But the redispersibility of concentrate dispersion at 1.5% and 2% tended to increase during storage.
3. The best concentration of carrageenan for snakehead fish concentrate dispersion was 1.5%.

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