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The Effects of Carrageenan Addition on The Quality of Broiler Chicken Meatballs

[1]Dioq Medi Syahputra, [1]Nazaruddin, [1]Siska Cicilia
[1]Department of Food Science and Technology, Faculty of Food Technology and Agroindustry, Mataram University, NTB, Indonesia
e-mail: siskacicilia@unram.ac.id (correspondence email)

Abstract

The purpose of this study was to determine the effect of adding carrageenan to the quality of broiler meatballs. The design of this study was a completely randomized design (CRD) with one factor, namely the concentration of carrageenan addition (A). There are 6 treatments, namely 0% (A1), 0.5% (A2), 1% (A3), 1.5% (A4), 2% (A5), and 2.5% (A6) with 3 repetitions. The parameters observed included chemical parameters (moisture content, ash content, protein, fat and fiber) and organoleptic parameters (texture, color, and taste) hedonic. The observed data were analyzed using Analysis of variance at a significant level of 5 %. If there is a significant difference, further tests are carried out using orthogonal polynomials for chemical parameters and Honest Significant Difference (BNJ) at the 5% level for organoleptic parameters. The results showed an increase in the concentration of carrageenan addition caused an elevate in water content, ash content, crude fiber content and protein but a decrease in fat content. Treatment A4 with 1.5% carrageenan is the best formula with a protein content, moisture, ash, fat, crude fiber of 16.94%, 17.12%, 0.85%, 2.38%, 1.65%, respectively and tend to be favored by panelists.

Keywords: broiler chicken, carrageenan, meatball

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INTRODUCTION

Broiler chickens have been widely consumed and developed because of their economic value in the form of meat (Yuwanta, 2004). Broiler chicken meat is thicker and has a softer texture than native chicken meat and is easily available in the market at an affordable price. Chicken meat has a high nutritional content because it contains carbohydrates, protein, fat, minerals and other substances that are useful for the body (Kusumaningrum et al., 2013). Chicken meat can be processed into various types of food, one of which is meatballs.

Meatballs are one of the most popular foods for people of all ages. Generally, meatballs are made from beef or chicken and tapioca. Utilization of chicken meat in general is a form of substitute for beef. The addition of tapioca up to 20% to beef meatballs produces meatballs with lower moisture content with organoleptic properties that are still favored by panelists (Aritonang, 2007). According to Indra (2016), the addition of 15% tapioca to African catfish surimi meatballs is the best treatment and the most preferred by consumers based on organoleptic and proximate parameters. The type of thickener used will affect the texture of the resulting meatballs. Besides tapioca, a thickener that can be used in making meatballs is carrageenan flour.

Carrageenan is a natural emulsifier extracted from red seaweed (*Kappaphycus alvarezii*). In addition to maintaining an oil-in-water emulsion in meatballs, carrageenan can also improve the texture of meatballs so that they are more chewy (Candra et al., 2014). According to Kurniawan et al. (2012), the addition of carrageenan in chicken meatballs has been shown to increase crude fiber content and yield, while the water-holding capacity of chicken meatballs tends to increase. The addition of carrageenan flour as much as 2.5% of the weight of the meat produced chicken meatballs with a chewy texture and high yield.

In the manufacture of catfish meatballs with the addition of carrageenan flour treatment of 1% of the weight of the meat produced the most preferred catfish meatballs in terms of appearance, aroma, texture and taste (Nurhuda et al, 2017). According to Yuliardianti et al (2014), the addition of 2% (w/w) carrageenan can increase the water holding capacity and elasticity of tuna fish balls. The addition of carrageenan flour with a concentration of 5% gave the best effect on the quality of snakehead fish balls (Karim & Aspari, 2015). Low fat high fiber meat kofta can be prepared by using 8.0% oat flour and 0.5% carrageenan without much detrimental effect on its physicochemical and sensory attributes (Modi et al, 2009). Ayadi et al. (2009) reported that increasing carrageenan concentration from 0.2 to 1.5% in turkey meat sausage caused reduction of emulsion stability, because of interfacial tension reduction between dispersed and continues phase in presence of carrageenan, and increased WHC. Garcia et al (2013) demonstrated the possibility of applying carrageenan to jerked beef in order to obtain an increase in the processing yield and a tender product while maintaining the sensorial quality and its intermediate-moisture meat product nature. Sensory panelists were rated highest score for 0.5% carrageenan added chicken nuggets and considered most accepted low-fat nuggets. Carrageenan (0.5%) may suitable be incorporated as fat replacer in meat products (Nayak et al, 2014). The aim of this research was to investigate the effect of addition carrageenan to the quality of broiler chicken meatballs.

RESEARCH METHOD

The method used in this study was an experimental method which is carried out in the laboratory, a completely randomized design (CRD) with one factor, namely the carrageenan concentration with 6 treatments, namely A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%) which repeated 3 times. The chemical parameters observed included chemical parameters (moisture content, ash content, crude fiber content, protein content, fat content), and organoleptic parameters (texture, color, taste) by hedonic test.

Meatball preparation

Formulation of chicken meatball can be seen in Table 1. Fresh chicken meat was purchased at a traditional market in Gerung, West Lombok, NTB. The first step was filleted the chicken meat to separate the chicken meat from the bones and skin. Furthermore, the chicken meat was ground until smooth and added with spices (pepper, garlic), carrageenan according to treatment (0%, 0.5%, 1%, 1.5%, 2%, and 2.5%). Meatball dough was shaped manually with a spoon and then steamed for 15 minutes at 100°C.

Moisture contents analysis

Determination of moisture content is done according to Sudarmadji et al. (2003) by thermogravimetric method. As much as 1 g sample is put into porcelain cup.

Samples were dried in an oven at 105°C for 3 hours. The sample is put in a desiccator and then weighed. This step is repeated until a constant weight is reached.

Ash contents analysis

Dry ashing procedures use a high temperature muffle furnace capable of maintaining temperatures of between 500 and 600°C (AOAC, 2005). Sample is put into porcelain cup and weighed before and after ashing to determine the concentration of ash present.

Table 1. Formulation of chicken meatball

	Weight (g)					
Ingredients	A_1	A_2	A_3	A_4	A_5	A_6
Chicken filet	250	250	250	250	250	250
Carrageenan	0	1.25	2.5	3.75	5	6.25
Tapioca	20	18.75	17.5	16.25	15	13.75
Pepper powder	12.5	12.5	12.5	12.5	12.5	12.5
Salt	6.25	6.25	6.25	6.25	6.25	6.25
Garlic	12.5	12.5	12.5	12.5	12.5	12.5
Ice cube	50	50	50	50	50	50
Total (g)	351.25	351.25	351.25	351.25	351.25	351.25

Fat contents analysis

Determination of fat content have done by soxhlet method (AOAC, 2005). Weigh 5 g of grounded and dried sample and place it in the thimble. Place the thimble in the soxhlet extractor and added hexane solvent. Continue the extraction process for 6 hours. Remove the condensing unit from extraction unit and place the sample in the oven at 105°C for 1 hour. The last step was taken the weight of the sample.

Protein contents analysis

Determination of protein content is done according to Sudarmadji et al. (2003) by Kjeldahl method. The sample was weighed and put into a Kjeldahl flask and destroyed using K_2SO_4 and H_2SO_4. The next step is distillation using NaOH solution. The last step was titration using 0.1 N NaOH.

Crude fibre analysis

Analysis of crude fibre have done by gravimetric method (AOAC, 2005). Sample was hydrolyzed with strong acid and dilute strong base to hidrolyzed and dissolved fat component, then filtered and washed with hot water contains acids and alcohol. Sample was burned and weighed.

Organoleptic properties analysis

The sample was fried in hot palm oil and placed on a plate that has been coded. Hedonic test was used 20 panelists asked to give an assessment of the texture, color and taste (SNI 7758:2013). All parameter was assessed in range score 1-5 (dislike-like).

Data analysis

Observation data were analyzed using Analysis of variance (ANOVA) at the 5% level using Co-stat software. If there was a significant difference, a further test is carried out using Orthogonal Polynomial for chemical parameters and Honest Real Difference (HRD) at the 5% level for organoleptic parameters.

RESULTS AND DISCUSSION

Moisture content

Moisture content is the amount of free water contained in food ingredients. Water content is one of the chemical properties that can determine the quality of food and processed products (Winarno, 2004). The relationship of the effect of carrageenan concentration on the moisture content of broiler meatballs can be seen in Figure 1.

Figure 1 shows that the higher the concentration of carrageenan, the water content of broiler meatballs produced increases with the regression pattern formed which is linear with the equation y = 1.1297x + 66.566 with coefficient of determination (KD) R^2 = 0.9006.

Moisture content of chicken meatballs in this study ranged from 66.65% - 72.92%The higher the concentration of carrageenan added, the more moisture content of broiler meatballs increased. This is due to the ability of carrageenan to bind water from the material. According to Hidayah et al (2019) states that the moisture content in broiler chicken is ±70%, while according to Ega (2016) states that the moisture content in carrageenan is 9.23%-11.31%. Carrageenan has binding, gelling, thickening and emulsion stabilizing properties. Carrageenan is a polysaccharide that acts as a binder. Modi et al (2009) also stated the ability of carrageenan to bind and trap water in a 3-dimensional gel matrix, thereby reducing the loss of moisture content because the moisture content is bound by carrageenan.

Ash content

Foodstuffs consist mostly of organic matter and water. Ash content is the residue of anorganic or mineral components contained in a food ingredient. The ash content of a food ingredient describes the amount of minerals that burn into non-volatile substances (Winarno, 2004). The relationship between the effect of carrageenan concentration on the ash content of broiler meatballs can be seen in Figure 2.

Based on Figure 2 shows that the higher the concentration of carrageenan, the ash content of the chicken meatballs produced is increasing with the regression pattern formed which is linear with the equation y = 0.1906x - 0.1813 with the coefficient of determination (KD) R^2 = 0.9304.

According to Hidayah (2019), the ash content in fresh chicken meat is 0.8-1%, while according to Nosa et al (2020), carrageenan has an ash content of 24.76%. The ash content produced in this study was 0.26%-1.27%. The highest value was obtained in 2.5% carrageenan. Ash content increased with carrageenan addition to meatballs. Similar results were reported by Demirici et al (2014), Garcia et al (2013) and Nayak et al (2014). Huda et al (2010) reported that a slightly higher ash content in Malaysian commercial beef meatballs, ranging from 1.76% to 3.4%.

Fat content

Fat is one of the most important food substances for the body and serves as an effective source of energy compared to carbohydrates and proteins. The relationship of the effect of carrageenan concentration on the fat content of broiler meatballs can be seen in Figure 3.

Based on Figure 3, it can be seen that the higher the concentration of carrageenan, the fat content produced decreases with the regression pattern formed which is linear with the equation y = -0.1423x + 2.9013 and with the coefficient of determination (KD) R^2 = 0.851. Fat content in chicken meatballs with the addition of carrageenan ranged from 1.89 to 2.75%. The higher the concentration of carrageenan added, the fat content of chicken meatballs will decrease. This particular functional property of water retention capacity of carrageenan in meat products has been

described as a fat substitute in the production of low-fat meat products (Candogan & Kolsarici, 2003). These results agree with those reported by Demirici et al (2014), Garcia et al (2013), and Modi et al (2009).

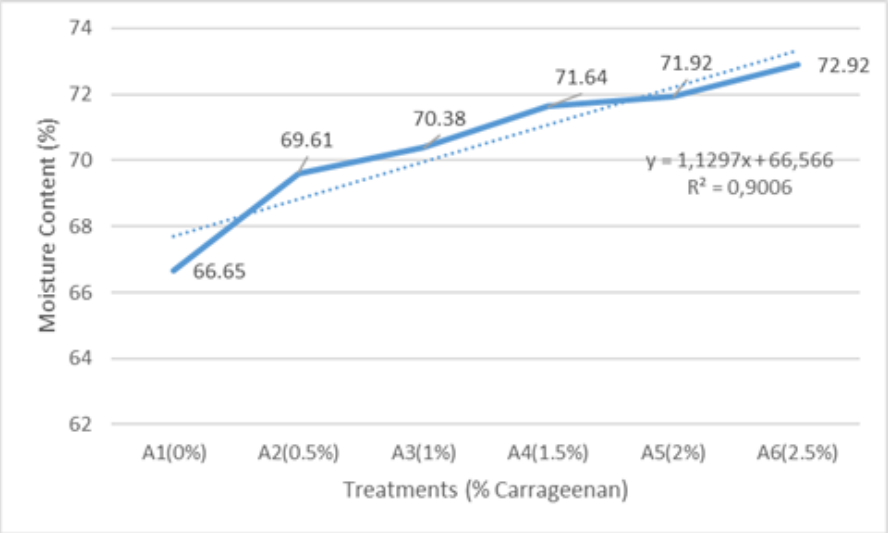

Figure 1. The moisture content of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 3 replications.

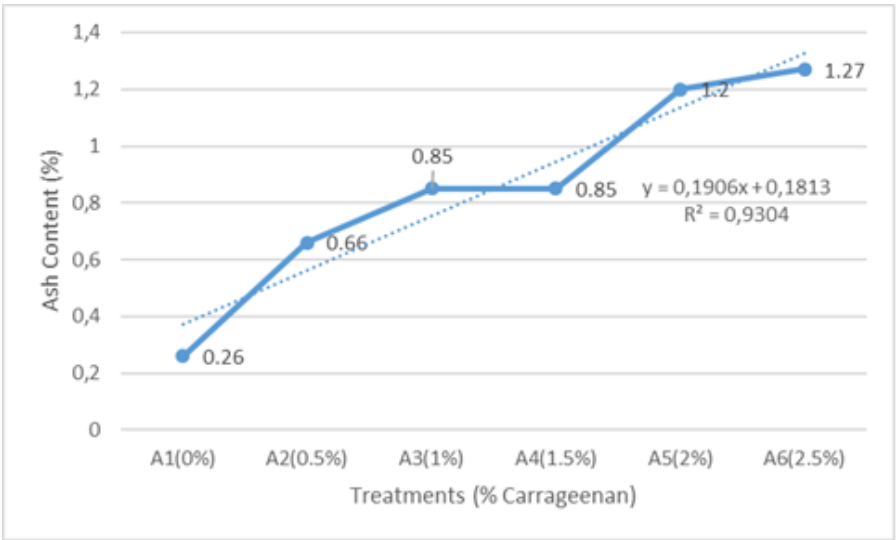

Figure 2. The ash content of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 3 replications.

Protein content

Proteins are composed of basic chemical units, namely amino acids. The amino acids in a protein molecule are linked together by a bond that called a peptide bond. One protein molecule can consist of 12 to 18 kinds of amino acids and can reach hundreds of amino acids (Winarno, 2004). The relationship between the effect of

carrageenan concentration on the ash content of broiler meatballs can be seen in Figure 4.

Figure 4 shows that the higher the concentration of carrageenan, the higher the protein content produced with the regression pattern formed which is linear with the equation y = 0.6591x + 14.065 with a coefficient of determination (KD) R^2 = 0.8811.

The higher the concentration of carrageenan added, the protein content of broiler meatballs increased. The addition of carrageenan in meatballs can increase the protein content of meatballs, it can be seen in the treatment without the addition of carrageenan protein content of 14.13% while the addition of carrageenan by 2.5% there is an increase in protein content of 17.63%. The same thing was reported by Anggraeni et al (2019), the addition of carrageenan caused an increase in protein levels in otak-otak. According to Demirici et al (2014), the addition of carrageenan resulted in a greater increase in protein content than other types of gums.

Crude fibre

Dietary fiber is a component of plant tissue that is resistant to hydrolysis by enzymes in the stomach and small intestine. Crude fiber is a part of food that cannot be hydrolyzed by chemicals used to determine crude fiber, namely sulfuric acid (H_2SO_4 1.25%) and sodium hydroxide (NaOH 1.25%). The relationship of the effect of carrageenan concentration on crude fiber content of broiler meatballs can be seen in Figure 5.

Figure 5 shows that the higher the concentration of carrageenan, the higher the fat content produced with the regression pattern formed which is linear with the equation y = 0.3294x + 0.2253 and with the coefficient of determination (KD) R^2 = 0.9903. The crude fiber content of chicken meatballs in this study ranged from 0.53 to 2.15%. The higher the concentration of carrageenan added, the crude fiber content of broiler meatballs increased. This is because chicken meat does not contain crude fiber while according to Ega (2016) states that carrageenan has a crude fiber content of 4.12% - 5.35% so that the greater the concentration of carrageenan flour given, the higher the crude fiber content of the meatballs. The fiber contained in carrageenan is a type of fiber that is soluble in water.

Organoleptic properties

Organoleptic testing is a test based on the sensing process. This test is subjective. The relationship between the effect of carrageenan concentration on organoleptic properties (color, texture, and taste) of broiler chicken meatballs can be seen in Figure 6.

Figure 6 shows that the carrageenan concentration treatment gave a significant effect on the texture of broiler meatballs. Panelists' assessment of the resulting broiler chicken meatballs ranged from 2.80 to 4.05 (rather like - like). This is because the resulting meatballs are more chewy because carrageenan functions as a thickener. According to Bahi (2020) the fragility which acts as a stabilizer and high water holding capacity during the meatball processing results in a higher texture value (more chewy). Texture is one of the properties of materials or products that can be felt by touching the skin or tasting.

Carrageenan concentration treatment did not give a significantly different (non-significant) effect on the taste of chicken meatballs. Panelists' assessment of the resulting broiler chicken meatballs ranged from 3.45 to 3.55 (rather like - like). This is because the chicken meatballs have a taste that is dominated by the taste of chicken meat so it is liked by the panelists so that the panelists tend to like it. According to Wibowo (2005) states that the taste of meatballs that meet the sensory quality

requirements is to have a delicious, delicious taste, a dominant meat taste and a flavor that is not excessive.

Carrageenan concentration treatment did not give a significantly different (non-significant) effect on the color of chicken meatballs. Panelists' assessment of the resulting broiler chicken meatballs ranged from 3.3 to 3.4 (rather like). This is because the chicken meat has a white color so that it dominates the color of the broiler meatballs. This is also in accordance with the statement of Sinurat (2007) which states that seaweed has no effect on the color of the resulting chicken meatballs. Meatball color is grayish white.

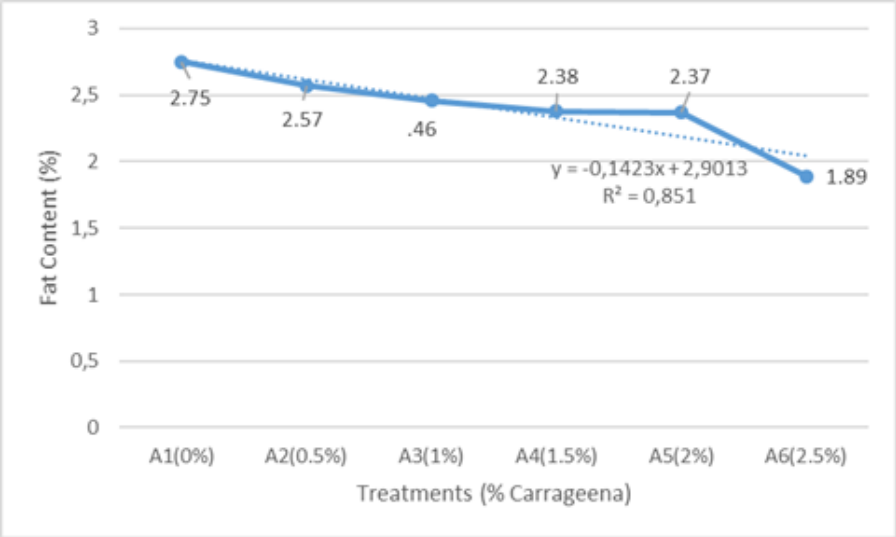

Figure 3. The fat content of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 3 replications

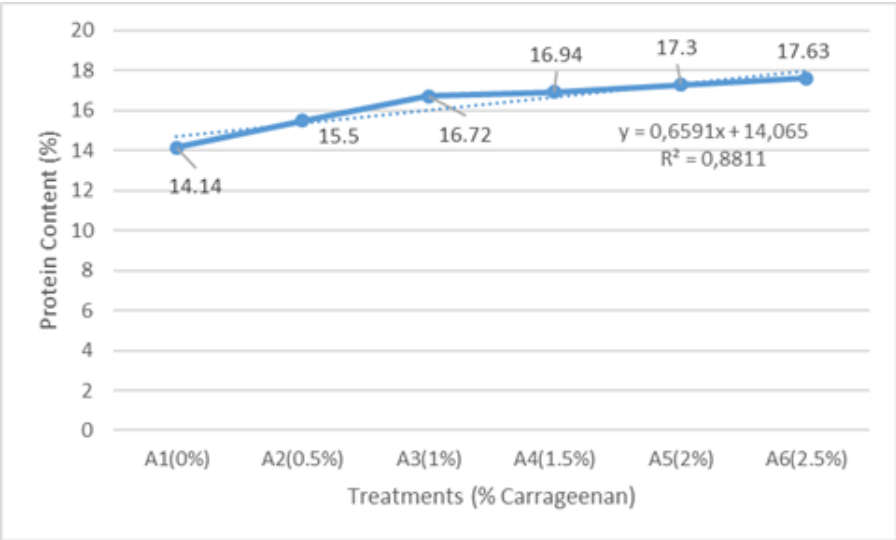

Figure 4. The protein content of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 3 replications

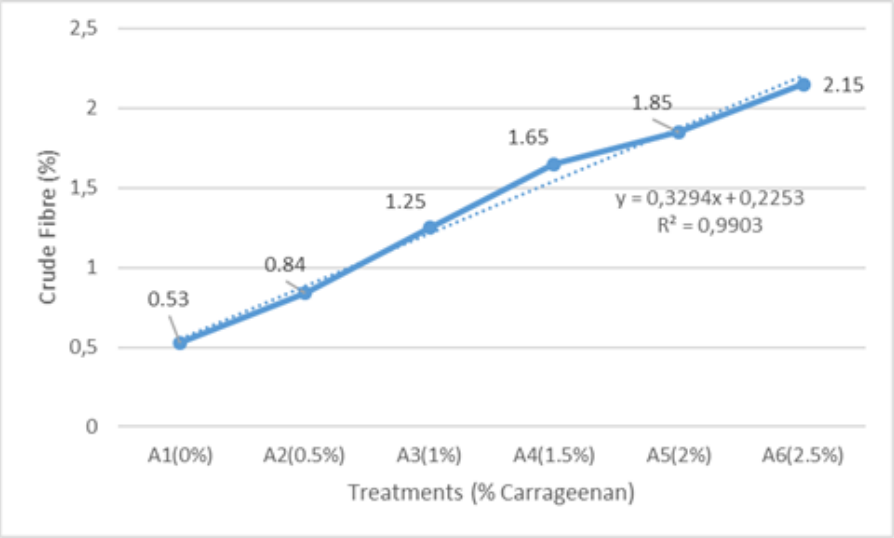

Figure 5. The crude fiber content of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 3 replications

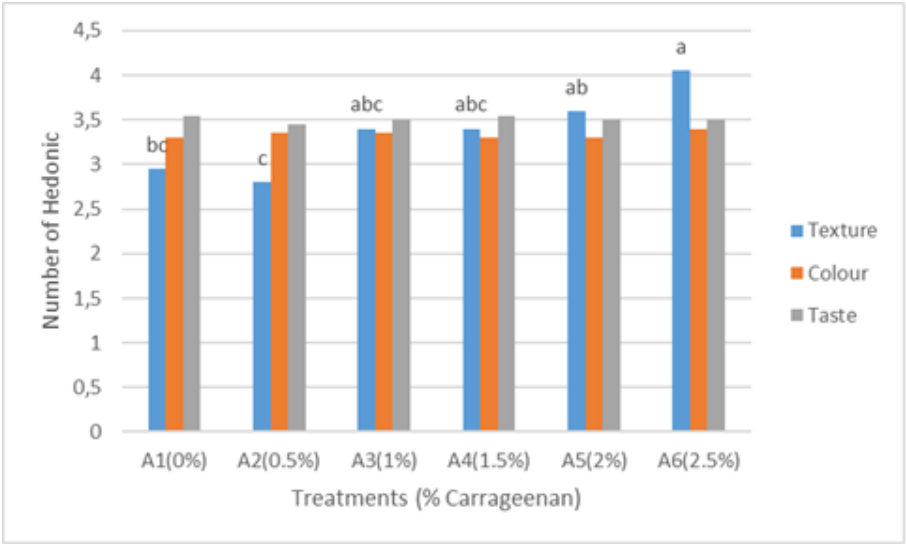

Figure 6. The hedonic score of chicken meatballs with different carrageenan concentration A1 (0%), A2 (0.5%), A3 (1%), A4 (1.5%), A5 (2 %) and A6 (2.5%). Data showed average from 20 panelist. Score 1-5 (like-dislike).

CONCLUSION

In general, carrageenan concentration has a significant effect on water content, ash content, protein content, fat, crude fiber, and color. Increasing of carrageenan concentration in the meatball formulation can elevate the moisture content, ash, crude fiber and protein but decrease the fat content and acceptability. The best formula was obtained in treatment A4 (1.5% carrageenan) with a protein content, moisture, ash, fat, crude fiber of 16.94%, 17.12%, 0.85%, 2.38%, 1.65%, respectively and tend to be favored by panelists.

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