

## **ALGINATE ADDITION ON GEBLEK**

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### **ABSTRACT**

The objective of this research was to obtain the appropriate alginate addition to the best physical, chemical, and sensory characteristics of Geblek. The experiment was arranged in a non-factorial Random Complete Block Design (RCBD) in four replications. The treatment given on each replication was the alginate addition that consisted of six different levels, they were 0% (A0), 1% (A1), 2% (A2), 3% (A3), 4% (A4), dan 5% (A5) (w/w). The data were evaluated by using The Smallest Real Difference Test (SRD) of 5%. The results showed that the appropriate concentration of alginate addition was 1% with the following criteria texture was not tough; preferred by panelists based on texture, colour, and taste attributes; has a hardness value of 0.475 mm/g/dt; water content of 39.864%;oil absorption of 5.567%, fat contentof 3.905% protein of 5.849%, ash of 2.039%, and carbohydrate of 40.776%.

Keywords: Alginate, Geblek, and quality of Geblek

### **Introduction**

Cassava was one of agricultural commodities in Indonesia which has a important role in fulfilling the national food needs because of its abundant availability. Fresh cassava tuber has a very low economic value at the big harvest time. Therefore, it requires effort to increase the added value of cassava tuber . One of cassava tuber diversification process was geblek. Geblek was one kind of traditional food from Kulonprogo, Yogyakarta. Raw materials of geblek were wet starch, cassava dregs, coconut slices or grated coconut and spices (Koesoemawardani, et al., 2016). The colour of geblek was cloudy white, printed in small ball or can be formed in another custom, when it was bitten likes a sluggish cracker, its taste was savory and most tasty was consumed a few minute after fried in while warm (Sije, 2013; Koesoemawardani, et al., 2016). One of the problem of geblek was its texture become hard in cold condition. Therefore, the innovation to improve its texture was dobe by using a binder material that can synergize with cassava tuber , especially in making geblek.

Ji-Sheng et al. (2011) states that alginate has groups of hydroxyl and numerous carboxyl, which determine the physicochemical and biological characteristics of alginates, even affecting their reactive functional groups. Thus, alginate was very flexible to be used in many potential applications of foodstuffs (Abd El-baki, 1982; Sim, 2011; Santana et al., 2013; Khoury et al., 2014; Fransiska et al., 2014; Rockower, et al, 1983 ; Ahmed et al., 1983) and non-foodstuffs (Davies et al., 1994; Mandal, 2006; Liew, et al., 2006). Therefore, this research uses alginate to improve the texture of geblek. The purpose of this research was to obtain appropriate addition amount of alginate in the making of geblek, in order to produce the best physical, chemical, and sensory characteristics of geblek.

## MATERIALS AND METHODS

The materials for making geblek were cassava tubers , sodium alginate, water, garlic, salt, coconut pulp, and grated coconut, while the other materials are materials for analyst. The tools were geblek processing tools, glass and instrument tools for analysis.

### Research methods

This research was arranged in nonfactorial within Randomized Complete Block Design (RCBD) consisting of 6 levels of alginate addition, ie 0%, 1%, 2%, 3%, 4%, and 5% (w / w). Results were expressed by means of values. Comparison of means performed by ANOVA and followed by LSD (  $p < 0,05$ )(Steel and Torrie, 1995). Fried geblek were evaluated on physical, chemistry, and sensory properties. Evaluation on sensory characteristic covers attributes of texture (hedonic and scoring methods), colour, flavor, and taste with hedonic methods (Meilgaard et al.,2006)). Evaluation of physical and chemical properties on geblek product were test of product hardness (Sumarmono, 2012), colour with Digital Image (Eko, 2012), water content (AOAC, 1984), and Oil Holding Capacity (AOAC, 1995). The best product from physical and sensory properties test result then will be tested on protein (AOAC, 2007) and carbohydrate content (by difference).

## Results and discussion

### Texture (Scoring test) and Hardness Level

The result of analysis of texture by scoring test and hardness level showed that the addition of alginate concentration has significant effect on geblek texture. This is in line with Santana et al (2013) study which stated that the addition of alginate has an effect on hardness, springiness, and cooking yield on soy sauce fish; Abd El-Baki et al (1982) states that alginate can increase water holding capacity (WHC), increased considerably the cooking yield of sausage and plasticity on fresh buffalo sausage. Sim et al (2011) states that sodium alginate can improve the texture of the wheat dough and the Chinese steamed bread to be softer for a long time during storage. The score of texture value of geblek product with the addition of alginate concentration of 0-5% is 2,65-4,02 which means hard, rather hard, and no hard texture (Table 1).

Table 1. Scoring test score on geblek texture with addition of alginate at various concentrations

Treatment	Middle Score
A1 (Alginates addition of 1%)	4,02 <sup>a</sup>
A0 (Alginates addition of 0%)	3,55 <sup>b</sup>
A2 (Alginates addition of 2%)	3,38 <sup>b</sup>
A3 (Alginates addition of 3%)	2,86 <sup>c</sup>
A4 (Alginates addition of 4%)	2,73 <sup>c</sup>
A5 (Alginates addition of 5%)	2,65 <sup>c</sup>
BNT0,05 = 0,416	

Note: Different numbers mean each treatment is significantly different in test on Least Significance Different (LSD) of 5% level

Based on the LSD test (Table 1) it is known that the value of geblek texture score with the addition of alginate concentration of 1% is significantly different with the texture value of geblek in the addition of alginate concentration of 0%, 2%, 3%, 4%, and 5%, while geblek texture with alginate concentration addition of 3%, 4%, and 5% were not significantly different. The highest score of geblek texture score was in addition of alginate concentration of 1% with a score of 4.02 (no hard), whereas the lowest score of texture scoring at Alginate concentration addition of 3%, 4%, and 5% with score 2.65-2,86 (rather hard)

Table 2. Hardness level of geblek with addition of alginate at various concentrations

Treatment	Middle Score
A1 (Alginates addition of 1%)	0,48 <sup>a</sup>
A0 (Alginates addition of 0%)	0,46 <sup>b</sup>
A2 (Alginates addition of 2%)	0,46 <sup>b</sup>

A3 (Alginates addition of 3%)	0,44 <sup>c</sup>
A4 (Alginates addition of 4%)	0,44 <sup>c</sup>
A5 (Alginates addition of 5%)	0,43 <sup>d</sup>
BNT0,05 = 0,008	

Note : Different numbers mean each treatment is significantly different in test on Least Significance Different (LSD) of 5% level

Based on LSD test (Table 2) it is known that the value of geblek texture score with the addition of alginate concentration of 1% is significantly different with the value of geblek texture in the addition of alginate concentration of 0%, 2%, 3%, 4%, and 5%. The highest hardness value was obtained at geblek with the addition of alginate concentration of 1% i.e. 0.48 mm / g / dt, while the lowest hardness was obtained at geblek with 5% alginate concentration treatment i.e. 0.43 mm / g / dt . In the frying process found expansion which determined by the water content of the material. According to Muliawan's (1991) research, this expansion is the result of a large number of explosions of chained water that evaporate rapidly during the frying process and simultaneously form air cavities that are spread evenly throughout the product structure. If the starch gelatinization process runs perfectly then will find more empty cavity and leave little space between the cavities. When product become cool, the empty cavity will shrink and make the texture geblek without the addition of alginate become hard.

The hardness level of geblek is influenced by the amount of water trapped by alginate in forming gel. Natrium alginate can bind water very strongly because it contains a large number of carboxylic anions (COO-) trapped in the three-dimensional structure (Marseno 1988, Ji-Sheng et al., 2011). If given alginate concentration is too high, geblek texture produced will get harder. This is directly proportional to research on the parameter of water content value, i.e. geblek with large addition of alginate concentration has low moisture value, if it's fried the amount of evaporated water will be less, thus the water content of the product will decrease. Low water content geblek has a high hardness level, and vice versa (Koesoemawardani et al., 2012). The influence of alginate addition to water content also found in Prawira research (2008), i.e. the alginate addition with high concentration, can produce low water content in kamaboko. Based on hedonic test on geblek, it was found that geblek with alginate addition of 1% yielded the most preferred texture with score 4.14 (very favorable).

## Colour

The analysis of variance result showed that the addition of alginate concentration had significant effect on panelist's hedonic score on geblek colour (Prawira, 2008; Syafarini,

2009; Santana et al. 2013) . Colour score of hedonic test of geblek product with the addition of alginate concentration of 0 -5 % is 2.25-4.29 which means the resulting texture is rather un-favorable, neutral, and very favorable.

Table 3. Hedonic score on the colour of geblek with the addition of alginate at various concentrations

Treatment	Median
A0 (Alginate addition of 0%)	4,29a
A1 (Alginate addition of 1%)	4,03ab
A2 (Alginate addition of 2%)	3,75b
A3 (Alginate addition of 3%)	3,30c
A4 (Alginate addition of 4%)	2,68d
A5 (Alginate addition of 5%)	2,25e
BNT0,05 = 0,318	

Note: Different numbers mean each treatment is significantly different in the Least Significance Different Test (LSD) of 5%

Table 3 shown that the hedonic value of geblek color with the addition of alginate concentration of 0% is not significantly different with the value of geblek color in the addition of alginate concentration of 1%, but significantly different with the color of geblek in the addition of alginate concentration of 2%, 3%, 4 %, And 5%. The highest hedonic value on colour is obtained in geblek with the addition of alginate, 1%, and 2% concentration with a score of 3.75-4.29 (favorable). Geblek with the addition of alginate at high concentration, making the geblek colour darker than Geblek with alginate addition at low concentrations. The addition of alginate in geblek of 0%, 1%, and 2% has a white to slightly brownish white appearances, while the addition of alginate 3%, 4% and 5% has a slightly brownish up to brownish appearance. Therefore geblek with the addition of alginate at high concentrations was less favorable to the panelists than geblek with the addition of alginate at low concentrations.

The result of the hedonic test on geblek colour is directly proportional to this research on color parameters analyzed by using digital image. Samples of geblek that categorized in the white threshold value is geblek with alginate addition treatment of 0%, while geblek with the addition of alginate of 1% to 5% not categorized in the white threshold value. Produced geblek with the addition of alginate 1% to 5% has a white brownish, slightly brownish up to brownish appearance. The effect of alginate addition to geblek color in line with Prawira research (2008), that is more alginate concentration added resulting in more lesswhite level in kamaboko, and it guessed related to the water holding capacity possessed by alginate. Kamaboko with high water binding capability has a lower brightness level compare to low one. Kamaboko with high water binding yield produced lower free water content in the product, causing the product becomes less bright, whereas kamaboko with low water binding capability produced high free water content causing the product becomes more brighter.

### Colour Using Digital Image Test

The process of capturing light by cones cell of human eye basically divided into three main groups, namely red (red), green (Green), and blue (Blue). Then they converted into HSI

colour modeling (Hue, Saturation, Intensity) to simplify the process of color clarification. Based on the results of color analysis using digital images of MATLAB applications obtained data as follows.

Table 4. HSI values in geblek colour with addition of alginate at various concentrations

Treatment	H	S	I
A0 (Alginate addition of 0%)	0,2038	0,2205	0,1658
A1 (Alginate addition of 1%)	0,1539	0,2852	0,1521
A2 (Alginate addition of 2%)	0,1527	0,2848	0,1520
A3 (Alginate addition of 3%)	0,1491	0,2822	0,1568
A4 (Alginate addition of 4%)	0,1487	0,2641	0,1535
A5 (Alginate addition of 5%)	0,1485	0,2621	0,1512

Hue (H) is an attribute or property of light used to distinguish colours and determine redness, greenness, and so on. The weakness and strength of this hue are described in saturation. Saturation (S) is a component used to describe the strength and fade of a colour received by the eye. Intensity (I) is an attribute that expresses the representation of the number, much of a light reflected or transmitted by an object (Kiswanto, 2012). According to Sije (2013 ), Geblek has a cloudy white physical appearance. An object can be said to be white if it has a threshold value of Hue between 0.2 to 0.7; Saturation value is between 0.01 to 0.3; And the Intensity value is between 0.1 and 1. Based on the MATLAB results, the samples which categorized in the white threshold value are geblek with 0% alginate addition treatment, while the geblek with the addition of alginate of 1% to 5% are not in the white threshold value. Produced Geblek with the addition of alginate 1% to 5% has appearance of a slightly brownish white, slightly brownish up to brownish.

### Picture



## Flavors

The results of analysis of variance showed that the addition of alginate concentration significantly affected the panelist's preference on the geblek taste. This is in line with Wanstedt et al's (1981) study; Ahmed et al. (1983). The score of hedonic on flavor of geblek products with the addition of alginate concentration of 0-5% was 2.35-4.12 (slightly favorable to very favorable).

Table 5. Hedonic score on the taste of geblek with the addition of alginate at various concentrations

Treatment	Mean
A1 (Alginate addition of 0%)	4,12a
A0 (Alginate addition of 1%)	3,93a
A2 (Alginate addition of 2%)	3,68b
A3 (Alginate addition of 3%)	3,06c
A4 (Alginate addition of 4%)	2,74d
A5 (Alginate addition of 5%)	2,35e
BNT0,05 = 0,229	

Note : Different numbers mean each treatment is significantly different in the Least Significance Different Test (LSD) of 5%

Table 5 shows the hedonic value of geblek flavor with the addition of alginate concentration of 1% is not significantly different with the hedonic value of geblek at the addition of alginate concentration of 0%, but significantly different with the flavor of geblek in the addition of alginate concentration of 2%, 3%, 4 %, And 5%. The highest hedonic value of taste was obtained at geblek with the addition of alginate concentration of 1% and 0% with score 3,93-4,12 (favorable), whereas the hedonic value on the lowest flavor was the addition of 5% alginate concentration with score 2,35 (un-favorable). Addition of alginate with higher concentration causes geblek has a bitter taste compared with the addition of alginate with lower concentrations. This results in products with high alginate concentration not favored by the panelists.

## Water content

The analysis of variance result showed that the addition of alginate concentration significantly affected the water content of geblek product. The value of water content of geblek products with the addition of alginate concentration of 0 - 5% is 41,532-31,554%.

Table 6. Value of geblek water content with the addition of alginate at various concentrations

Treatment	Mean
A1 (Alginate addition of 0%)	42,53 <sup>a</sup>
A0 (Alginate addition of 1%)	39,86 <sup>b</sup>
A2 (Alginate addition of 2%)	37,91 <sup>c</sup>
A3 (Alginate addition of 3%)	35,86 <sup>d</sup>
A4 (Alginate addition of 4%)	34,55 <sup>d</sup>
A5 (Alginate addition of 5%)	31,55 <sup>e</sup>

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$$\text{BNT}_{0,05} = 1,922$$


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Note: Different numbers mean each treatment is significantly different in the Least Significance Different Test (LSD) of 5%

Table 6 shows that the water content of geblek with the addition of alginate concentration of 0% is significantly different with the water content of geblek on the addition of alginate concentration of 1%, 2%, 3%, 4%, and 5%. The highest water content value was obtained in geblek with the addition of 0% alginate concentration that is 42.53%, while the lowest geblek hardness value was at the addition of 5% alginate concentration that is 31.55%. The ability of alginate in water binding was very high, more alginate concentration given to geblek, then it shows the tendency of more lower water content produced, and vice versa, less alginate concentration given to geblek, more higher the water content (Prawira, 2008; Mastuti, 2008; Koesoemawardani, et al 2012). Sodium alginate can bind water very strongly because it contains large amounts of carboxylic anion ( $\text{COO}^-$ ). The water binding able to form gel because the large amount of water trapped in the three-dimensional structure). When dissolved in water, sodium alginate will form a mesh-like grid that can bind strongly many water molecules and hold water-soluble well (Marseno, 1988; Ji-Sheng et al., 2011). The increased concentration of Na-alginate allows more chemical reaction of gel formation. Gel formation causes free water in tendon to be used for forming complex bonds of gel matrix consisting of water-protein-polysaccharides, so less free water in the meat system (Prawira, 2008).

### Oil Absorption Strength

Oil absorption strength is the amount of oil absorbed in the product during the frying process. Oil absorption is obtained from the reduction of fat content value after fried with water content value before frying. Analysis of Variance result (Table 43) showed that the addition of alginate concentration had significant effect on the absorption of oil of geblek products. The absorption capacity of geblek oil with the addition of alginate concentration of 0-5% was 5,58-15,62%.

Table 7. Oil Absorption Strength of geblek with the addition of alginate at various concentrations

Treatment	Mean
A0 (Alginate addition of 0%)	15,62 <sup>a</sup>
A1 (Alginate addition of 1%)	10,41 <sup>b</sup>
A2 (Alginate addition of 2%)	9,83 <sup>c</sup>
A3 (Alginate addition of 3%)	9,23 <sup>d</sup>
A4 (Alginate addition of 4%)	7,19 <sup>e</sup>
A5 (Alginate addition of 5%)	5,58 <sup>f</sup>

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$\text{BNT}_{0,05} = 0,098$

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Note: Different numbers mean each treatment is significantly different in the Least Significance Different Test (LSD) of 5%



Table 7 shows that the absorption of oil in geblek among all treatments of alginate concentration addition is different. The highest oil absorption is obtained in geblek with the addition of 0% alginate concentration, while the lowest oil absorption is obtained in geblek with the addition of alginate concentration of 5% . If more alginate concentration is given, then the less absorption of oil in geblek happens.

According to Dalimunthe's (2014) study, the strength reduction of oil absorption is due to decreased water content and fat content, so in the frying process will create less water-filled cavities, then the water will out and fill by oil. This is in line with the value of moisture content in this study, ie higher moisture content results in higher product oil absorption, whereas low moisture content results in low oil product absorption. High temperatures cause more dehydration on the surface of the material so that there is more empty space filled with oil (Ketaren, 1986). The fried foods have the same structure, they are outer zone surface, crust and core. The absorbed oil used for soften food crust, match with the amount of water that evaporates during frying.

### **Best Treatment**

The best product selection is based on the results of geblek products testing with organoleptic, physical, and chemical parameters. Geblek with the addition of 1% alginate treatment is the best product which has a texture that is no hard criteria; favored by panelists based on texture, color, and taste attributes; Has a hardness value of 0.475 mm / g / dt; water content of 39,864%; and oil absorption of 5,567%.

### **CONCLUSION**

Based on the results of research that has been done, it can be concluded that the appropriate concentration of alginate addition to the best physical, chemical, and organoleptic characteristics of geblek, is geblek with the addition of alginate of 1% which has a texture that is not hard; Favored by panelists based on texture, color, and taste attributes; Has a hardness value of 0.475 mm/g / dt; Water content of 39,864%; Oil absorption of 5,567%, fat content of 3,905%, protein of 5,849%, ash content of 2,039%, and carbohydrate level of 40,776%.

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