KAJIAN KONSENTRASI *FIRMING AGENT* DAN METODE PEMASAKAN TERHADAP KARAKTERISTIK *FRENCH FRIES TARO* (*Colocasia esculenta*)

ARTIKEL

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FIRMING AGENT AND CONCENTRATION STUDY COOKING METHODS CHARACTERISTICS OF FRENCH FRIES TARO (COLOCASIA ESCULENTA)

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ABSTRACT

The objective of this study was determined the concentration of firming agent and cooking methods on the characteristics of french fries taro.The design used in this study to analyze the data from the experiment is a simple linier regression with the independent variable (x) is the concertrasion of firming agent consisting of 0.5%, 1%, and 1.5% and cooked method at frying methods of 170^0C and drying method of 70^0C. The dependent variable (y) consists of the water content, and total sugar content.Preliminary observations by using the organoleptic test scoring responses obtained type of firming agent is selected $NaHCO_3$ 1% with a grayish-white color attributes, texture, mouthfeel, and taste of taro.

The results of primary research french fries taro has been done on the method of frying at a temperature of 170^0C, a drying method at a temperature of 70^0C and soaking firming agent with a concentration of 0.5%, 1%, and 1.5% showed a correlation temperature cooking method and the concentration of firming agent $NaHCO_3$ to decreased levels of water and total sugar content indicated by the value of the correlation coefficient (r) of linear regression on a combination of each treatment. Correlation coefficient (r) combination of temperature varies with the concentration of $NaHCO_3$ firming agent remains on water content values obtained for all treatments r = 1; and the correlation coefficient (r) a combination of firming agent $NaHCO_3$ concentration that varies with the temperature remained on water content is R70 = -0.15554; R_{170} = -0.3273. While the influence of the concentration of firming agent interaction $NaHCO_3$ and cooking methods on water content of french fries taro leave regression value 0.05 which showed a significant regression coefficient with a value of R Square 0.86 = 86% means that the model fit is quite good. Correlation coefficient (r) combination of temperature varies with the concentration of $NaHCO_3$ firming agent remains on the total sugar is $r_{0.5}$ = 1; r_1 = -1; $R_{1.5}$ = 1; and the correlation coefficient (r) a combination of firming agent $NaHCO_3$ concentration that varies with the temperature stays the total sugar content is R_{70} = 0.9640; R_{170} = 0.8686. While the influence of the concentration of firming agent interaction $NaHCO_3$ and cooking methods of the total sugar content of french fries taro give 0.0597 regression that shows the regression coefficient is not significant to the value of R Square 0.85 = 85% means that the model fit is quite good.

Test results Scoring french fries taro best sample is a sample a2b1 is soaking firming agent $NaHCO_3$ 1% with a frying pan at a temperature of 170^0C which has a water content of 18:50%, and sugars are a total of 30.69% and the hardness is equal to that obtained with the measurement of premises using texture analyzer tool equel 4979,99 g force.

PRELIMINARY

The need for food increases with the increase of population. Various types of food produced by increasing the quantity and quality to meet the food needs of the community. In addition to the increase in numbers, food needs can also be done by optimizing the use of food sources are diverse. This is done as food diversification efforts by using local food resources.Tubers are vegetable materials obtained from the soil, such as cassava, sweet potatoes, potatoes, arrowroot, turmeric, yam, onion and ginger, kencur, purse, Dioscorea esculenta, canna, yam, taro, and so forth (Muchtadi, 2010) , Types of tubers in Indonesia could be improved such as taro tuber production. Taro tuber can grow in almost all regions but most good growth area, namely that have a height of between 900 to 1,200 m with a desired rainfall of about 1,200 mm per year (but less than it would hold up in partumbuhannya). Improved product taro tuber can be useful as an addition to foodstuffs and sources of nutrients (protein). Handling and processing in addition to improving farmers' income as well as a source of foreign exchange. For rainfed areas, with all minimal irrigation, the plants can grow, as long as the soil is well done processing.Development of taro plants will be useful for providing additional food or rotation of staple foods, in addition to easy planting, production of the tuber is also very good, the protein content of both the fresh roots or who undergo treatment process would remain impartial or not much different from that contained (Kartasapoetra, 1994). One example of a commodity tubers which have almost no place despite having a high economic potential is taro. Though the group of taro plants can be found in almost every Indonesian archipelago, but taro development centers in Indonesia are in the city of Bogor and Malang were able to produce some cultivars delicious taste tuber (National Export Development Agency, 2005).Indonesia is a country producer of taro, species such as taro Bogor, taro Padang or taro Belitung (purse), taro Beneng, and the type of taro others scattered in Bogor, Cianjur, Brass, Cisarua and Pangalengan in West Java, Waterford and Mount Lawu in Central Java and Malang in East Java. One local food resources which can be used as an alternative diversification efforts is the tuber of taro (Colocasia esculenta). Bogor taro tuber production reached 57 311 tonnes in 2008 (Bappeda Bogor, 2008).According Onwueme (1978) as cited by kafah (2012), taro tuber starch consists of 17-28% amylose while the remaining 72-83% is amylopectin. Taro tuber protein content is higher than other tubers such as yams, cassava, and yam. The protein content is rich in essential amino acids, but the number of histidine, lysine, isoleucine, and methioninnya tryptofan low.Taro tuber contains the potential of carbohydrates and protein, minerals Ca and P were quite high, both mineral essential for the formation of bones and teeth strong. In addition, also contains vitamins A, C, B1 bit (Rukmana, 1998, in Kafah, 2012). Based on the content of nutrients and abundant production of taro be a great opportunity to serve as the raw material of nutritious food products, quality and has a longer shelf life to the modification of preservation as well as French fries products.French fries are a kind of snack that is usually made from potatoes. This product is a fried potato half cooked and then frozen. Because it has undergone a preliminary cooking, preparation for consumption is faster and easier (Daniawan et al., 2011). According Adiyogya (1999) constraints of availability of raw materials (varieties) that are suitable for the manufacture of french fries causes most of these products are imported in the form of frozen French fries.

Table 1. Data Consumption and Imports of Frozen Potato Chips in Indonesia

No	Year	Consumption (Tonnes)	Import (Tons)
1	2006	973.510	51.750
2	2007	989.195	100.770
3	2008	972.019	72.000
4	2009	1.078.520	81.500
5	2010	1.014.900	71.560
6	2011	1.138.920	76.420
	Average	**1.027.845**	**75.667**

Source: BPS, 2012 in Andriyanto et al., 2013.

Based on the consumption and import of potatoes can be concluded that the number of public demand for processed potatoes are offset by lifestyle modernization that makes the government took the decision to import potatoes in Indonesia. Although actual consumption data is sufficient to meet the consumption of potatoes but the government still import to Indonesia, it is caused by the demand of consumption of processed potatoes for frozen potatoes (French fries).

Development-based processed food French fries taro tuber is one attempt to reduce the number of imported potatoes for frozen potatoes, but it is also a diversification of food made from local availability of raw materials abundant taro tuber. Currently processing taro mostly utilize fresh tubers into various processed products usually diinovasikan into many different types of snacks ranging from taro chips, snack sticks taro, milk taro, cake taro, taro roll, brownies taro, donuts taro, dodol taro, shredded taro, mochi taro, taro ice cream, noodles taro and others who tend to have shelf life is relatively short compared to processed food that can be frozen like French fries Taro. The hallmark of french fries alone compared to chips sticks usually are more priority in terms of appearance, color and crispness when consumed, it depends on any treatments carried out both before and during the ripening process cooking.

Processing french fries consisted of preparation taro tuber which includes sorting, washing I, and trimming, then the process of making french fries taro including raw material preparation, weighing, cutting, soaking I, soaking II, soaking III, draining I, freezing I, frying I or drying, draining II, II freezing, frying II and III draining, and observation.

Soaking using a firming agent and cooking methods is an important process in determining the crispy texture which is a dominant characteristic of the product produced, for the optimal concentration needed in the cooking process is suitable to produce french fries taro with best quality.

METHODOLOGY

Materials and tools

The raw material to be used is talas Bogor as much as 20 kg obtained from the market Lembang, water, cooking oil, sodium bicarbonate, sodium tripolyphosphat, and salt.

The tools will be used in the research process, namely fryer, cabinet dryer, stove, basins, plastic trays, scales, knives, cutting boards, and freezer.
The tools used for chemical analysis, namely mortar pestle to crush the sample, the flask 100 ml brands Pyrex to dilute the sample, Erlenmeyer flasks 250 ml brands Pyrex for storing samples to be titrated, pipette, pipette 10 ml brands Pyrex to shed indicators, burettes brands Pyrex and stative for titration, penetrometer to measure hardness,

balance of digital to weigh the sample, a Bunsen burner to heat, porcelain dish brands Pyrex for a sample of water content, eksikator to cool the material samples, oven to dry samples of moisture content, and a spray bottle to store distilled water.

The tools used for physical analysis of the texture analyzer.

Research methods

The preliminary study will determine the best type of firming agent include sodium bicarbonate and sodium tripolyphospate the same concentration of 1% is used for immersion. Furthermore, the manufacture of french fries, fried taro. Response organoleptic tests on french fries taro produced include texture, color and taste of french fries taro conducted with the test method used is scoring test using 20 panelists. Preliminary Research Flowchart can be seen in Figure 1.

The main research consists of the design of treatments, experimental design, design response.

Fakor and standards of treatment are as follows:

1. The first factor is the concentration of firming agent selected (a):

a1: 0.5%

a2: 1%

a3: 1.5%

2. The second factor is the cooking method (b):

b1: Frying pan at a temperature of 170^0C

b2: Drying at a temperature of 70^0C

The experimental design used in this study is a simple linear regression replicated 4 times.

The draft analysis is performed to find or define the relationship between the independent variable on the dependent variable will be done by calculating the correlation between the two variables on the response measured. The correlation coefficient or r can be calculated with the formula described by Sudjana (2005):

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{(n\sum X^2) - n\sum X^2}.\sqrt{(n\sum Y^2) - n\sum (Y)^2}}$$

Draft responses made in this study include chemical response, response organoleptic and physical responses.

1. Chemical response

Chemical response that is done in this study include the determination of water content gravimetric method (AOAC, 2005) and a total sugar content luff Schoorl method (AOAC, 2005).

2. Response Appearance

Response french fries taro organoleptic test conducted by scoring. Parameter organoleptic test covering is the texture, color, and taste of taro best french fries with a concentration of firming agent and a proper process. Test scoring is done by 20 panelists, where panelists were asked to score on each sample with a predetermined scale (Soekarto, 1985).

Table 9. Criteria Test Scoring

Intensity	Numerical Scale
Very good	6
Good	5
Rather good	4
Somewhat good	3
Not good	2
Very good	1

Source: Soekarto, 1985.

3. Response Physics

Response physics made is the level of violence after the texture of French fries fried taro. These measurements using a texture analyzer. The procedure of making french fries taro research in the preliminary study includes three activities, namely the

preparation of meat tuber taro, taro process of making french fries and organoleptic observations, the following stages:

A.Persiapan taro tuber:

1. Sorting

Sorting aims to sort taro tubers are ripe and not ripe. mature taro tuber flesh used for making french fries taro. Bulbs taro taro is selected that has a uniform level of maturity that is harvested at 6-9 months.

2. Wash I

The washing process is done manually using clean water aims to remove dirt on the skin of tubers.

3. Trimming

Capturing the tuber flesh is done by peeling the tubers of taro then the tuber flesh. taro tuber in trimming aims to be disposed of parts that are not used on the skin in the form of taro tuber. This process is done manually by hand using a knife.

B. The process of making French fries taro

The process of making french fries taro done several phases, as follows:

1. Raw Material Preparation

The materials used in the preliminary study is a taro tuber flesh. Other raw materials used sodium bicarbonate, sodium tripolyphospate, salt, water, and cooking oil.

2. Cutting

Taro tuber cutting process is done to reduce the size of the tuber of taro by means cut elongated shape with a length of 7 cm, or in accordance with the size of the bulbs were available and 0.7 cm thick. The cutting process is done manually using a stainless steel knife.

3. Weighing

Weighing process is done to determine the weight of the material to be used for the preparation of french fries taro.

4. Immersion I

Taro pieces and then soaked by using a 1% salt solution for 20 minutes to remove oxalate levels in taro, then drained.

5. Immersion II

Taro chunks then soaked again by using water for 3 hours to remove residual salt and sediment that may still adhere to the meat taro tuber, then drained.

6. Immersion III

Taro pieces that have been drained and then divided into two containers to be soaked with a 1% solution of sodium carbonate and sodium tripolyphospate 1% for 40 minutes.

7. draining I

Taro pieces that have been muted then diriskan for 10 minutes.

8. Freezing I

Freezing is done after the taro drained, freezing carried out at a temperature of -26.5 for 18 hours.

9. Frying I

Toasting the first stage is performed at a temperature of 170^0C for 1 minute with a method of deep frying. Frying process is done in a frying pan in which pieces of taro submerged in the oil until the inside of the half-baked taro pieces and most of the water content decreases.

10. draining II

Pieces that are deep fried taro and then drained for 5 minutes, avoiding sticking together and allowed to cool. If it is cold, the pieces can be frozen taro.

11. Freezing II

Pieces of fried taro then stored back in the freezer temperature -26.5^0C for ± 18 hours.

12. Frying II

Toasting the second stage is carried out at a temperature of 170^0C for 2 minutes by deep frying method depends on the level of dryness pieces of taro.

13. draining III

French fries taro then drained to reduce the oil content after frying.

C. Observations

The resulting product then performed organoleptic test method of scoring by 20 panelists, with a grayish-white color attributes, texture, mouthfeel, and taste of french fries taro. The procedure of making french fries taro research on primary research includes the following phases:

1. Raw Material Preparation

The materials used in the main study is the tuber of taro. Other raw materials used types firming agent selected in the preliminary study of the use of sodium bicarbonate or sodium tripolyphospate, salt, water, and cooking oil.

2. Trimming

Capturing the tuber flesh is done by peeling the tubers of taro, then the tuber flesh. taro tuber in trimming aims to be disposed of parts that are not used on the skin in the form of taro tuber. This process is done manually by hand using a knife.

3. Cutting

Taro tuber cutting process is done to reduce the size of the tuber of taro by means cut elongated shape with a length of 7 cm, or in accordance with the size of the bulbs were available and 0.7 cm thick. The cutting process is done manually using a stainless steel knife.

4. Weighing

Weighing process aims to determine the weight of the material to be used for the preparation of french fries taro.

5. Immersion I

Pieces of meat taro tuber then soaked by using a 1% salt solution for 20 minutes to eliminate the levels of oxalate in the taro, and then drained.

6. Immersion II

Taro pieces and then soaked again by using water for 3 hours to remove residual salt and sediment that may still adhere to the meat taro tuber, then drained.

8. Immersion III

Taro pieces that have been drained and then soaked with a firming agent selected during the preliminary research with various concentrations (0.5%, 1% and 1.5%).

9. draining I

Taro pieces that have been muted then diriskan for 10 minutes.

10. Freezing I,

Freezing is done after the taro drained, freezing performed at -26.5^{0}C temperature for 18 hours.

11. The process of ripening

Taro chunks of the drained then grouped to experience different cooking process, namely drying at 70^{0}C for 1 hour and frying at a temperature of 1700C for 1 minute by using varying concentrations of each agent firming 0.5%, 1% and 1.5%.

12. draining II

Pieces that are deep fried taro and dried then drained, for 5 minutes. If it is cold, taro chunks stored in the freezer.

13. Freezing II

Taro pieces that have been drained and then stored back in the freezer temperature -26.5ºC for ± 18 hours.

14. Frying II

Toasting is carried out at a temperature of 170^{0}C for 2 minutes by deep frying method depends on the level of dryness pieces of taro. Oils used in frying has a function as a heat transfer medium and provide flavor (blend of flavors and aromas) specified in the final product. Frying process is done in a frying pan in which pieces of taro submerged in the oil so that it will help increase the porosity of the material after the water lost during the frying process, thereby increasing kerenyahannya of french fries taro.

15. draining III

French fries taro then drained to reduce the oil content after frying. 16. Observations

French fries taro fries is then performed analyzes (chemical, organolepti, and physical).

Flowchart of preliminary research and primary research can be seen in the following figure Figure:

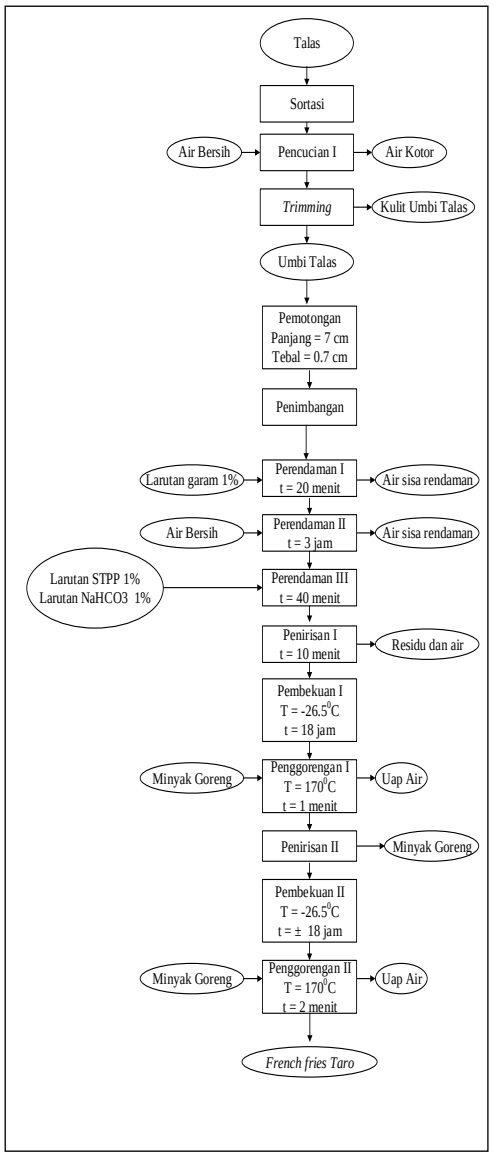

Figure 1. Flowchart of Research Introduction Making French Fries Taro

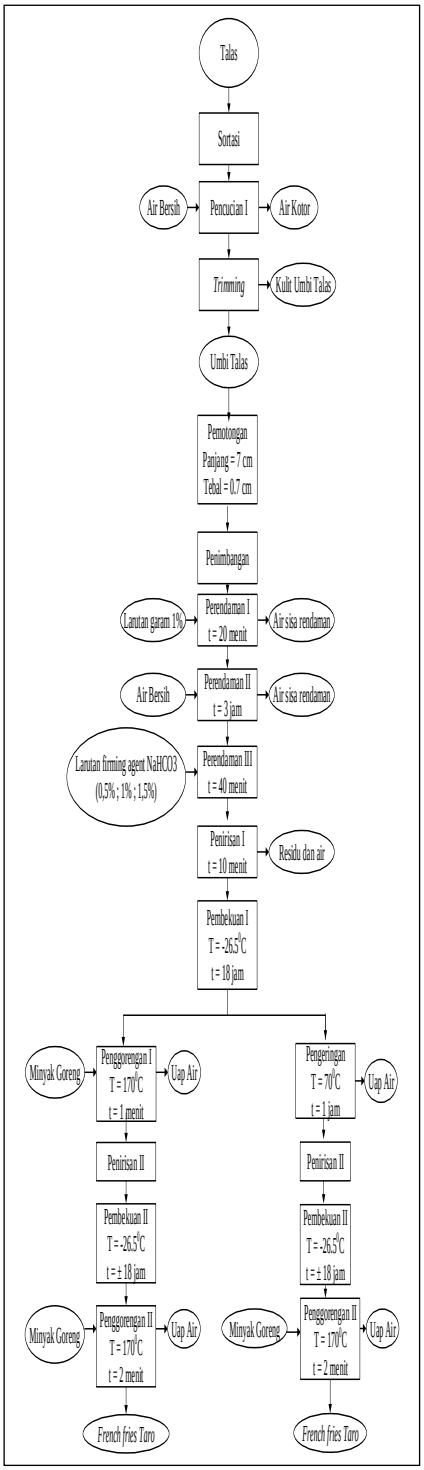

Figure 2. Flowchart of Research Primary Making French Fries Taro

PRELIMINARY RESEARCH RESULTS

Based on statistical analysis using test by 20 panelists scoring obtained by the average value of the two treatments, immersion using $NaHCO_3$ 1% and immersion using STTP 1%. Preliminary observations scoring test can be seen in Table 2.

Table 2. Test Results Scoring French Fries Taro By Type firming agent

Type firming agent	Average value		
	color grayish white	Texture *Mouthfeel*	taste Taro
471 (STPP 1%)	3.90	2.50	4.00
539 ($NaHCO_3$ 1%)	3.95	4.70	4.70

Selection of the best Taro French Fries product through the test scoring is based on the highest average value of each attribute grayish-white color, texture mouthfeel and taste of taro.

Based on the scoring table after comparison test, it can be seen that the samples with 539 samples of code that uses immersion $NaHCO_3$ 1% has the highest average value.

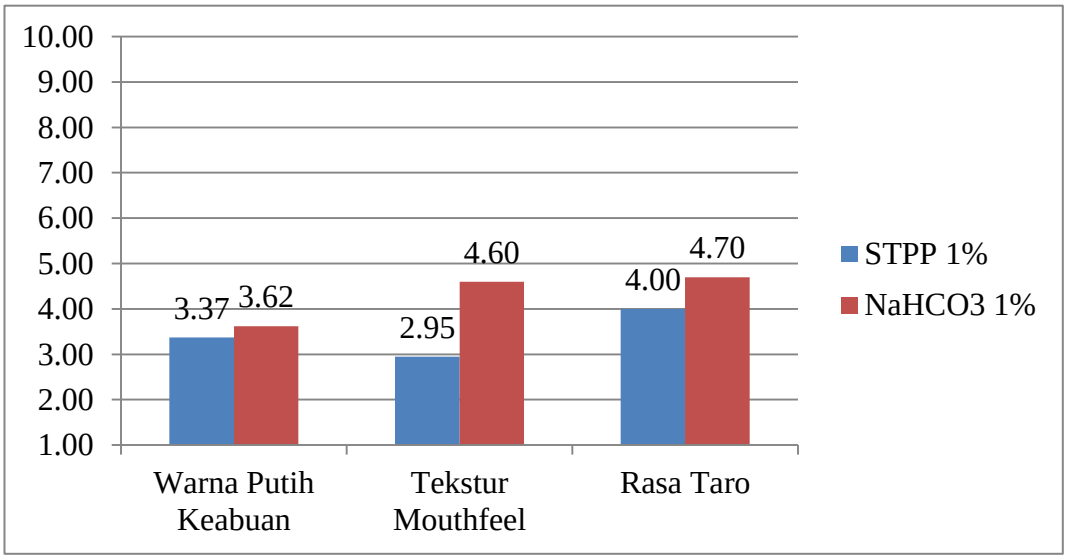

Figure 3. Graph Test Result Scoring French Fries Taro By Type Firming Agent

Based on the graph 3, can know the number of the highest average value of grayish-white color, texture mouthfeel and taste of taro is sampled by immersion using $NaHCO_3$ 1%. The test results showed the samples scoring the most preferred by the panelists is sample code 593 (immersion $NaHCO_3$ 1%), which produces the color, texture, and taste the best.Figure 3 shows the amount of the average value of both these types of firming agent in terms of grayish white color attributes and taro flavor has an average value that is relatively the same. As for the texture mouthfeel attributes results showed the average value of the average value of the difference is quite significant. The highest value of the attribute texture mouthfeel that is sampled by immersion

using $NaHCO_3$ 1% means that the sample has a textured mouthfeel of the most preferred in comparison samples by immersion using STPP 1%, it is suspected that sodium bicarbonate ($NaHCO_3$) is one of the baking and perenyah fried form white powder, when mixed into the dough will produce CO_2 (Winarno, 1992).

According to Shinta et al, (1995), reported that the material for the treatment of immersion in a solution of $NaHCO_3$ undergoing a process of evaporation of water faster. $NaHCO_3$ solution will lead to the formation of CO_2 gas onto the surface of the cooking oil quickly when heated. At the time of immersion, $NaHCO_3$ solution will get into the cracks and pores of the material and joins the water contained in the material. These gases which form pores or voids in the material. Therefore the number of cavities in the material, the mass of material to be low and the material to be easily vulnerable to the load or force from outside given to him. The more pores are formed, the texture of French fries taro produced will be more crisp.

Major Research Results

Chemical Analysis Moisture French fries taro

Water is an important component in food ingredients, since water may affect the appearance and texture. The water content in foodstuffs in determining acceptability, freshness and durability of these materials (Winarno, 2002).

Determination of water content was conducted to determine changes in water levels after the second frying french fries taro done frying cooking methods at temperatures of 70^0C to 170^0C and drying soaking $NaHCO_3$ concentration variation that is different is 0.5%, 1% and 1.5%. French fries taro analysis results are shown in Table 3.

Table 3. Analysis of Water Content French Fries Taro

Cooking methods	firming agent $NaHCO_3$ Concentration (%)		
	0.5%	1%	1.5%
	Average Moisture French Fries Taro		
Fryers (170^0C)	17.50%	18.50%	17.00%
Drying (70^0C)	12.00%	14.50%	11.50%

The data in Table 3 shows the average water content Taro experiencing French Fries cooking method on the temperature and the concentration of $NaHCO_3$ different firming agent, showing the water content of the different French Fries Taro for all treatments. The different levels of water french fries Taro affected by different cooking methods with each of the predetermined temperature.

Method of drying at a temperature of 70^0C with soaking konsentarasi firming agnet $NaHCO_3$ 1.5%, show the average water content of french fries taro smaller than other treatments.

The treatment effect of cooking methods with concentration agnet $NaHCO_3$ same firming against moisture reduction french fries taro can be seen in Figure 4.

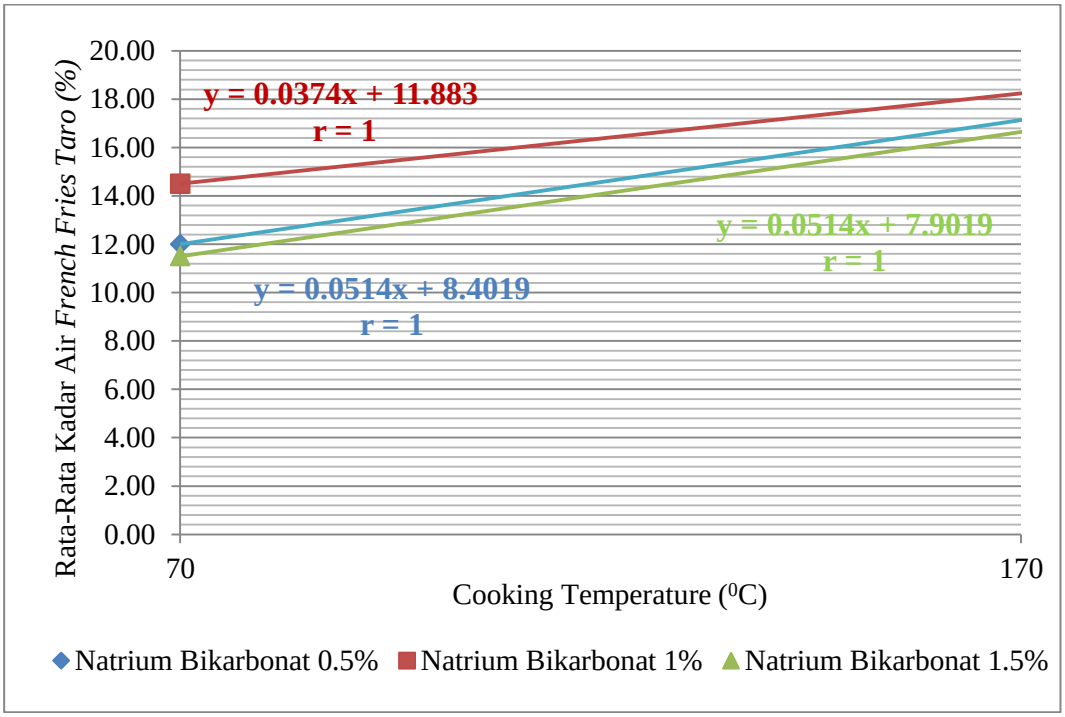

Figure 4. Linear Regression To The Effect of Temperature Cooking French Fries Taro Water Content

Figure 4 shows the cooking method that is different from the respective predetermined temperature is the method of frying at a temperature of 1700C and drying at a temperature of 700C with a concentration of firming agent NaHCO3 same for every cooking method showed the water content of french fries taro decreased for all treatment combinations , Based on Figure 14, shows the cooking method with the established temperature on water content of french fries taro can be seen from the correlation coefficient of the linear regression equation, as shown in Table 4.

Table 4. Effect of Temperature Cooking Against Correlation Coefficient Values

Concentration Firming Agent $NaHCO_3$ (%)	Temperature Cooking (^{0}C)	Linear Regression Correlation Coefficient Values
0.5	70	r = 1
	170	
1	70	r = 1
	170	
1.5	70	r = 1
	170	

Treatment methods of cooking drying at a temperature of 70^{0}C and 170^{0}C frying with firming agent concentration $NaHCO_3$ 0.5%, 1%, and 1.5% showed a correlation coefficient of linear regression r = 1 for all types of combined treatment.

Data Table shows a very strong correlation cooking method to water content of french fries taro indicated by the correlation coefficient between the direct cooking temperature with moisture content of french fries taro. Treatment cooking method with the established temperature in this study provide direct influence on water content.

Effect of physical and chemical properties of taro occurs during the drying process and a second frying pan before frying. The decline in water levels are very strong at drying method at a temperature of 170^0C for 1 hour. Drying taro as raw material for the french fries basically had three main objectives. First, lowering the water level to low enough, so that the product can be stored longer before being fried. Second, get a certain moisture content is critical to the process of the formation of cavities in the frying stage. Third, reduce the absorption of oil in the frying stage.

The drying process using the cabinet dryer for 1 hour causes the water easily evaporated because of the hot air in a dryer. The longer the heating time, the breakdown of the components of the material increase so that the amount of bound water liberated more. Free water contained in tubers such as taro in parts of the network will evaporate in the drying process, so that when the process of frying deep frying, taro faster evaporation of water, and the resulting reduction in moisture content greater. While the method of frying the average initial moisture content is higher because of time spent in a moment of 1 minute at a temperature of 170^0C, while also using the method of frying deef frying to make taro undercooked use oil as a medium of heat is enough to increase the number water content in french fries taro is produced, it is suspected because of the water content in the taro result of freezing I still have high levels enough water so that the high water content of taro during frying early, causing more absorption of oil but the evaporation of the water has not reached the maximum consequently the water content at the beginning of the frying method will be more than the method of drying.

The treatment effect of firming agent concentration $NaHCO_3$ different cooking methods at the same temperature the moisture reduction french fries taro can be seen in Figure 5.

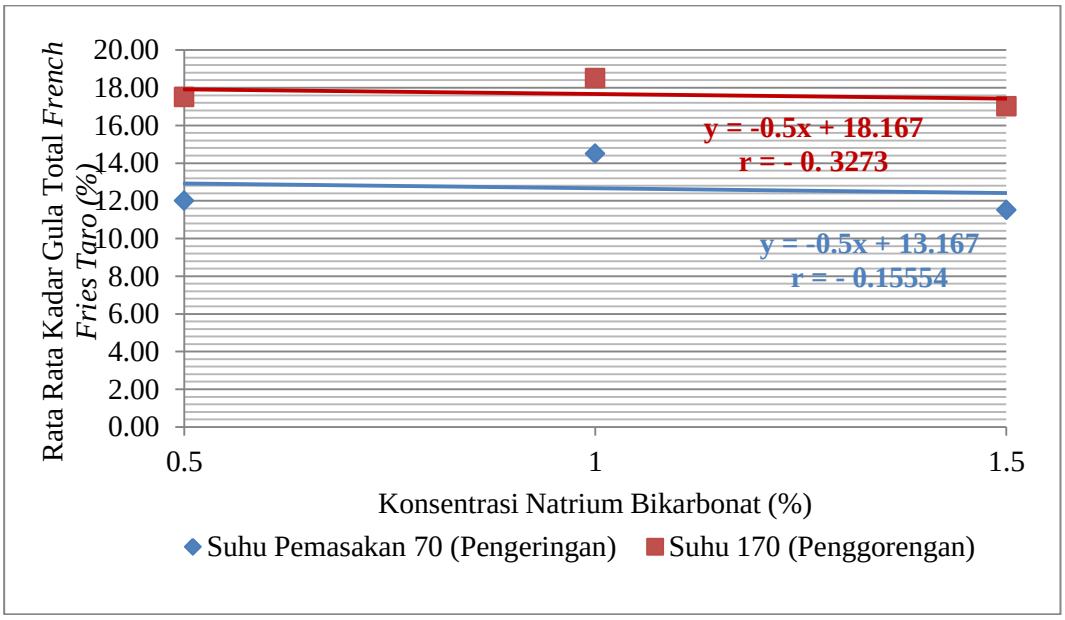

Figure 5. Regression Effect Concentration Against $NaHCO_3$ Agent Firming Moisture French Fries Taro

Based on Figure 5, shows the concentration of firming agent $NaHCO_3$ is added at the time of immersion varies of 0.5%, 1%, and 1.5% with the concentration of firming agent showed the water content of french fries taro different for all treatment combinations. determination temperature cooking method is the same for each concentration of firming agent showed the water content of french fries taro different for all treatment combinations. The correlation coefficient value for each treatment method of cooking and the concentration of $NaHCO_3$ firming agent used in the second fryer can be seen in Table 5.

Table 5. Effect of Temperature Cooking Against Correlation Coefficient Values

Cooking temperature (^{0}C)	Concentration Firming Agent $NaHCO_3$ (%)	Value Linear Regression Correlation Coefficient
70	0.5	r = - 0.15554
	1	
	1.5	
170	0.5	r = - 0.3273
	1	
	1.5	

Soaking treatment concentration of firming agent $NaHCO_3$ 0.5%, 1%, and 1.5% by the method of drying at a temperature of 70^{0}C and a method of frying at a temperature of 170^{0}C to demonstrate the value koefisisen correlation of linear regression for each treatment is r = - 0.15554 and r = - 0.3273.

Table shows there $NaHCO_3$ firming agent concentration relationship to water content of french fries taro indicated by the value of the correlation coefficient (r) for all treatment combinations are negative on any cooking temperature. This negative correlation shows the linear relationship between the concentration of indirect $NaHCO_3$ firming agent with the water content of french fries taro. NaHCO3 concentration treatments firming agent in this study provide no direct influence on the reduction in water content, it is suspected because of the different uses of each treatment $NaHCO_3$ concentration is very small, so that the effect of the decline in water levels had no effect. However, the soaking concentration of 1.5% showed the water content of the lowest, at any temperature cooking it is suspected because of CO_2 produced from soaking with a concentration of 1.5% more being compared with a concentration of 0.5% and 1%, materials for the treatment of immersion in a solution of NaHCO3 experience water evaporation process faster.

Putranto, et al (2013), describes $NaHCO_3$ solution with a high concentration of CO_2 will cause more of that will go to the surface of the cooking oil quickly when heated. At the time of immersion, $NaHCO_3$ solution will go into cracks or pores of materials and combine with water contained in the material. At the time of frying, the release of CO_2 gas is so much and so quickly will evaporate the water in the material very quickly as well, resulting in water content decreases.

Firming Agent Interaction Effect of $NaHCO_3$ concentration and Cooking Methods on Water Content French fries taro

Based on statistical analysis, shows the cooking method (b) as well as the interaction agent concentration Friming $NaHCO_3$ (ab) gives the value of regression 0.05 which showed a significant regression coefficient means that the regression model is feasible because a significant number did not exceed 0:05. While based on the table Model Summary acquired R Square (coefficients of determination) is 0.86 = 86%, matching the model is said to be good because close to 1, meaning that the effect of the concentration of firming agent $NaHCO_3$ and cooking methods on water content of french fries taro by 86% and the rest is influenced by factors another 14%.

This is because at the time of the second frying, the release of CO_2 gas is so much and so quickly will evaporate the water in the material very quickly as well and resulted in decreasing water content.

Temperature and drying time is an important factor in the drying that will affect the quality of the final product (Heldman and Lund, 2007). At the time of frying deep frying, the evaporation of water at the surface of the material more quickly than the evaporation of water in the material, resulting in a decrease in moisture content greater. Increasing frying temperature allows the moisture reduction of input materials are substituted with cooking oil during the frying process. High temperatures will cause evaporation of water and the loss of volatile components in the food (Fellows, 1990).

Analysis of Blood Sugar Total French Fries Taro

Taro contains carbohydrates ranged from 13-29% with the main component is starch, which reached 77.9%. Taro tuber starch consists of 17-28% amylose, the remaining 72-83% is amylopectin. High levels of amylopectin in causing taro taro is fluffier and sticky like sticky rice. Besides the advantage of taro starch is easily digestible (Onwueme, 1994)

Taro tuber also contains oligosaccharides, especially raffinose. Oligosaccharides are not digested in the small intestine, but into the large intestine. In the large intestine, rafinosa fermented by microflora produces a variety of gases, such as methane (CH_4), carbon dioxide (CO_2) and hydrogen (H_2).

Determination of total sugar content was conducted to determine changes in levels of total sugar after frying french fries both on taro done frying cooking methods at temperatures of 70^0C to 170^0C and drying soaking $NaHCO_3$ concentration variation that is different is 0.5%, 1% and 1.5%. French fries taro analysis results can be seen in Table 6.

Table 6. Analysis of Blood Sugar Total French Fries Taro

Cooking methods	firming agent $NaHCO_3$ Concentration (%)		
	0,5%	1%	1,5%
	Average Blood Sugar Total French Fries Taro		
Fryers (170^0C)	30.68%	30.69%	32.33%
Drying (70^0C)	29.58%	31.22%	31.80%

Table 6 shows the average total sugar content after frying French fries taro cooking methods both with treatment at a

predetermined temperature and soaking $NaHCO_3$ firming agent with different concentrations showed a total sugar content different in each treatment.

According DKBM Indonesia Bogor taro tuber carbohydrate content of 25%. As for carbohydrate content by libraries steamed taro has a carbohydrate content of 28.2%, a carbohydrate content carbohydrate content on taro are not undergoing a process of soaking, freezing, drying and frying.

Process cooking starch can cause gel formation, soften and break up the cells, thus simplifying the process of digestion. At the time of ingestion of all forms of hydrolyzed starch into glucose (Almatsier, 2004).

The results of the analysis of treatment effect on the cooking method established temperature and concentration of firming agent $NaHCO_3$ showed an average correlation with total sugar levels after a second frying pan. Correlation effect soaking cooking temperature and the concentration of firming agent $NaHCO_3$ with different treatment can be seen in Figure 16, using the linear regression equation.

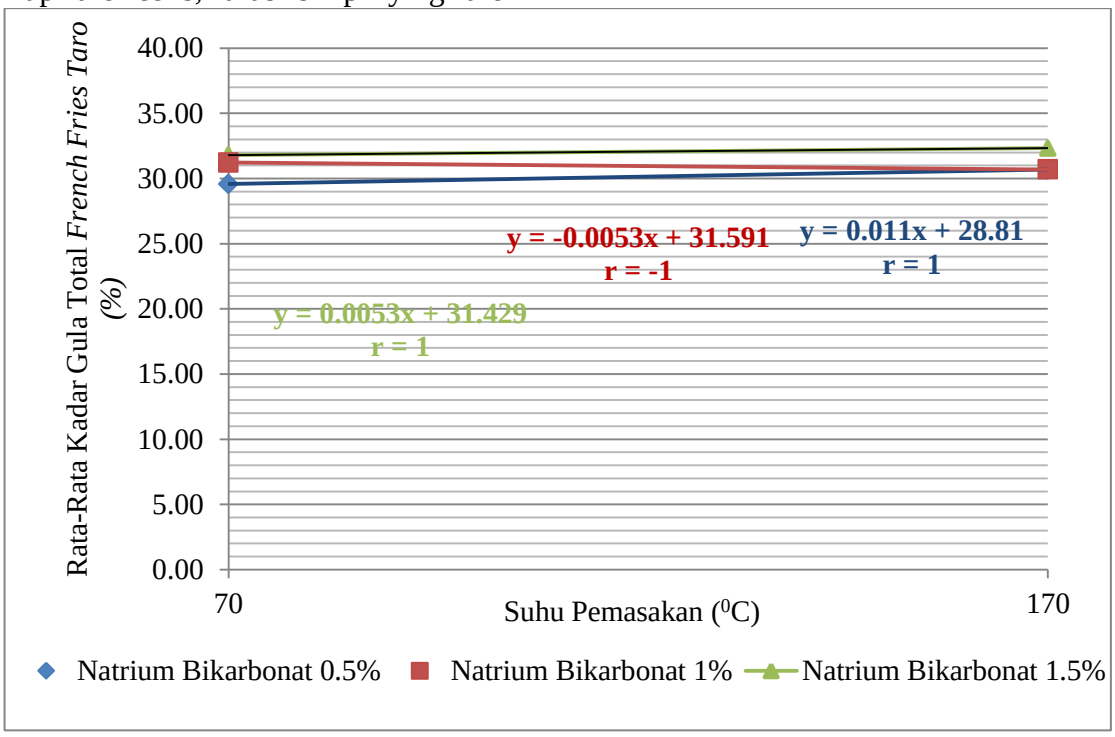

Figure 6. Linear Regression To The Effect of Temperature Cooking French Fries Sugar Levels Total Taro

Based on Figure 6 shows the method of cooking french fries taro which varies the drying temperature of 70^0C and frying at a temperature of 170^0C with a concentration of firming agent $NaHCO_3$ same for each cooking temperature showed a total sugar content of different combinations for all the carrying. The correlation coefficient for each treatment cooking temperature and the concentration of firming agent

french fries $NaHCO_3$ taro seen in Table 8.

Table 8. Effect of Temperature Cooking Against Correlation Coefficient Values

Concentration Firming Agent $NaHCO_3$ (%)	Temperature Cooking (^{0}C)	Linear Regression Correlation Coefficient Values
0.5	70	r = 1
	170	
1	70	r = - 1
	170	
1.5	70	r = 1
	170	

The data in Table 8 shows the correlation coefficient influence of cooking temperature is drying at a temperature of 70^{0}C and frying at a temperature of 170^{0}C to average levels of total sugar french fries taro with a concentration of firming agent $NaHCO_3$ different shows to a concentration of 0.5% and 1.5% has a coefficient same correlation is 1, which suggested a direct linear relationship is perfect, and to a concentration of 1% had a correlation coefficient value -1, which showed a direct correlation that has no direct linear relationship between the perfect cooking temperature to average total sugar content. The average yield showed a drying method at a temperature of 70^{0}C had higher levels of total sugar lowest, it is presumably because at the time of drying will reduce most of the water content, the loss of water content in taro makes it difficult starch to be degraded into glucose so that the bonds between water molecules with various components other materials, including starch, become weaker or more easily broken. Compact starch granules causes the starch is composed of amylose and amylopectin difficult to solve the leash, so the starch has not tergelatanisasi. As for the method of frying at a temperature of 170^{0}C sugar levels total is relatively higher, this is presumably due to the high temperatures cause gelatinization process exceed temperature gelatinisasinya so french fries taro half cooked generated even more tender, with the growing granules of starch, hydrogen bonding will weaken that will facilitate penetration of amylase enzyme to break glucoside bond in starch and ultimately change starch into glucose. Water evaporation causes the formation of an empty cavity and decreased levels of starch for gelatinization reactions occur in the material.

The heating process will cause the starch granules become swollen due to water absorption more. Development of starch granules also due to the entry of water into the granule and is caught on the composition of the molecules making up starches for amylose and amylopectin molecules physically defended only by weak hydrogen bonds. The hydrogen atoms of the hydroxyl groups will be attracted to the negatively charged oxygen atoms of other hydroxyl groups. When the temperature of the suspension rises, the hydrogen bond is getting weaker, while the kinetic energy of the water molecules increases, weakening the intermolecular hydrogen bonding of water. Starch heated in a critical temperature in the presence of excess water, granule will mengimbibisi water, swell and some starch to be dissolved in the solution characterized by changing starch suspension which was originally turbid become transparent and will certainly affect the viscosity increase. Natural starch granules are insoluble in water, but can be dissolved in water when

the suspension of starch is heated above the temperature gelatinisasinya.

The chemical changes of starch can add stability to the state pH extremes and heating (retorting), the stability of the form of sol and gel from the cycle of liquid-frozen (freeze-thaw cyclus), the concentration of the media sugary and ability to join the groceries the other (Buckle, et al., 1987).

Basically the loss of solids due to the ripening also be caused by less optimum starch matrix binding tergelatinisasi starch that is not tergelatinisasi (Merdiyanti, 2006).

The size of the starch granules can affect starch gelatinization profile. Starch which has a large size would have a relatively low gelatinization temperature and maximum viscosity is high enough. This is due to the starch granules absorb water more easily so it will tergelatinisasi at lower temperatures and are able to absorb a lot of water before granulanya rupture which can then reach a high maximum viscosity (Kusnandar, 2011).

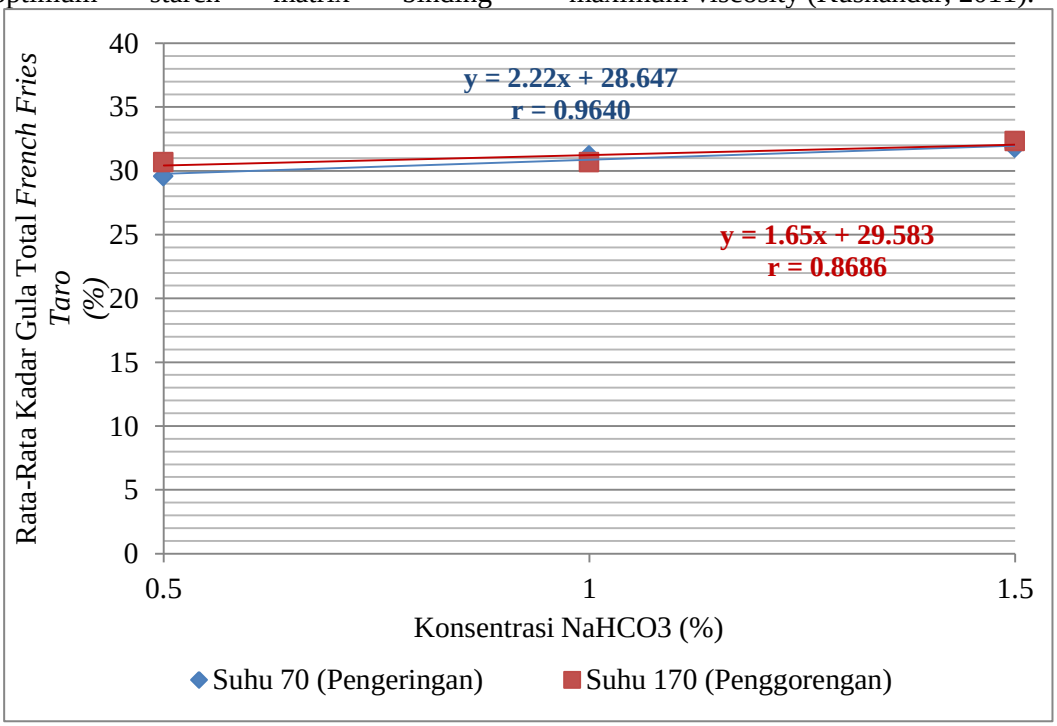

Figure 7. Linear Regression Effect Concentration $NaHCO_3$ Firming Agent Against Blood Sugar Total French Fries Taro

Based on Figure 7 shows the concentration of firming agent $NaHCO_3$ were added to the immersion french fries taro varied of 0.5%, 1%, and 1.5% with the cooking temperature is the same for each concentration of firming agent $NaHCO_3$ showed levels of total sugar french fries taro different for all combinations treatment. The correlation coefficient for each treatment cooking temperature and the concentration of $NaHCO_3$ firming agent used in the second frying french fries taro can be seen in Table 9.

Table 9. Effect of Temperature Cooking Against Correlation Coefficient Values

Cooking temperature (^{0}C)	Concentration Firming Agent $NaHCO_3$ (%)	Value Linear Regression Correlation Coefficient
70	0.5	r = 0.9640
	1	
	1.5	
170	0.5	r = 0.8686
	1	
	1.5	

Soaking treatment firming agent $NaHCO_3$ concentration of 0.5%, 1%, and 1.5% with the cooking temperature 70^0C showed a correlation coefficient of linear regression is r = 0.9640. The treatment temperature is the same as above with the concentration of $NaHCO_3$ firming agent used in immersion taro ie 170^0C shows the linear regression coefficient was r = 0.8686. The data in Table 16, shows a strong correlation to the concentration of firming agent $NaHCO_3$ total sugar content of french fries taro indicated by the value of the correlation coefficient (r) is positive. This shows a direct correlation is even stronger because the value closer to 1 between the concentration of $NaHCO_3$ firming agent with a total sugar content after frying french fries taro second. $NaHCO_3$ concentration treatments firming agent in this study provide direct influence on levels of total sugars.

The more the concentration of sodium bicarbonate is added, the amount of bound water liberated bond will be. Thus, starch is degraded in a material that accompanied the release of water. Starch degradation would cause a decrease in starch content so that the lower the starch content of the material will cause a decrease in the ability of the material to retain water due to loss of hydroxyl groups that play a role in the absorption of water. Hydroxyl groups on the starch granules are a major factor in affecting the ability of retaining water.

Firming Agent Interaction Effect of $NaHCO_3$ concentration and Cooking Methods on Sugar Levels Total French Fries Taro

Based on statistical analysis, shows the cooking method (b) as well as the interaction agent concentration Friming $NaHCO_3$ (ab) gives regression value 0.0597 which showed no significant regression coefficient means that the regression model is said to be unfit for significant numbers exceed 0:05. As for the two variables X1 and X2 F count and F table shows the F count> F table, it means that there is a relationship or correlation between one variable with other variables. According to the table Model Summary acquired R Square (coefficients of determination) is 0.85 = 85%, matching the model is said to be good because close to 1, meaning that the effect of the concentration of firming agent $NaHCO_3$ and cooking methods on the level of total sugar french fries taro by 85% and the rest is influenced by factors another 15%. Total sugar content depends degraded starch which will then undergo

gelatinization process that would break down the starch granules are composed of amylose and amylopectin. The compact size of the granules of starch in taro causes difficulty starch degraded to glucose and thus require cooking temperature is high, while the use of cooking temperature is closely associated with the evaporation of water content in the material, it takes the moisture content in order to achieve gelatinization process so that the bonds between water molecules with different other components of the material, including starch, become weaker or more easily broken.

Soaking with a firming agent $NaHCO_3$ with varying concentrations varying impact on the water content, the more the concentration of $NaHCO_3$ were added, the number of bound water liberated bond will be. At the time of frying, the release of CO_2 gas is so much and so quickly will evaporate the water in the material very quickly as well, resulting in water content decreases. Evaporation of water quickly turned out to be only a slight expansion of gas or formation of pores. In this short time experiencing the ripening form of starch gelatinization and rapid evaporation of water that leaves the cavities of air (Irzam, 2014).

Appearance response test Scoring French Fries Taro

Test Scoring aims to give a score of grayish white color attributes, taro flavor, mouthfeel and texture as well as to choose the best samples on french fries taro. This test is performed by 20 panelists, in scoring this test panelists were asked to score / value on each sample french fries Taro to grayish-white color attributes, taro flavor, mouthfeel and texture, where the highest score declared the best sample. Scoring test research results to grayish-white color can be seen in Table 10.

Table 10. Test Results Scoring grayish-white color of French Fries Taro

Treatment	Average Value
a1b1	4.18
a1b2	4.13
a2b1	4.19
a2b2	4.11
a3b1	4.06
a3b2	3.91

Based on table 10, test scoring for sample number 6 and number 20 panelists panelists with four replications obtained an average value of the attribute grayish-white color of french fries taro on each treatment is relatively stable..

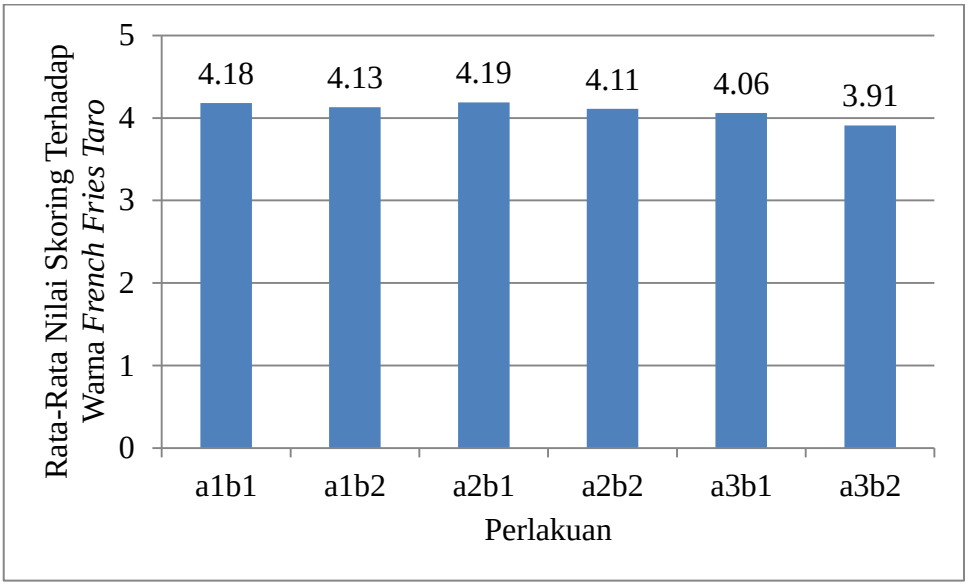

Figure 8. Test Results Scoring Against grayish-white color of French Fries Taro

Figure 8 shows the total value of the highest average for white-gray french fries taro is a sample a2b1 namely immersion $NaHCO_3$ 1% on the method of cooking fryer at a temperature of 170^0C with a value of 4:19, meaning that this sample has a white color grayish most preferred panelist or have a score given the highest panelist. While the total value of the lowest average against white grayish french fries taro is a sample a3b2 is soaking $NaHCO_3$ 1.5% on the cooking method of drying at a temperature of 70^0C with the average value of 3.91, indicating that the sample a3b2 is a sample of french fries taro least preferred by the panelists in terms of grayish white color french fries taro. The average yield relatively stable value of scoring on any treatment that is grayish-white color, it is because the use of firming agent $NaHCO_3$ concentration and different concentrations of each treatment is very small, making it difficult to distinguish panelists.

Colour is an important quality index for food products, especially in this case the quality of french fries dihasilkan.Warna taro which has an important role for a food product, whether it is not undergo any processing or food product processing results, together smell, taste, and texture plays an important role on the level of acceptance of the food product by the panelists.

Table 11. Test Results Scoring mouthfeel texture of French fries taro

Treatment	Average Value
a1b1	3.56
a1b2	2.60
a2b1	3.91
a2b2	2.91
a3b1	4.01
a3b2	2.03

Based on table 11, test scoring for sample number 6 and number 20 panelists panelists with four replications obtained an average value of the

attribute mouthfeel texture of french fries taro on each treatment had a mean value is rather good.

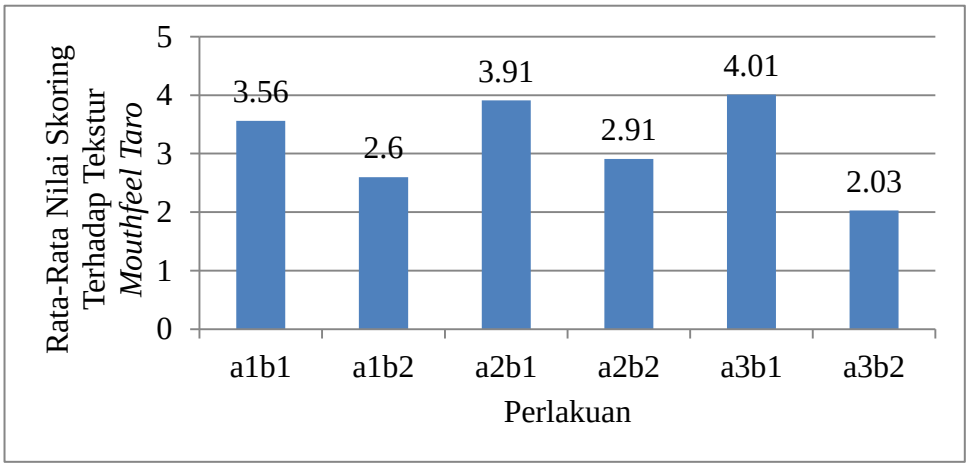

Figure 9. Test Results Scoring Against mouthfeel Textured French Fries Taro

Figure 9, the average yield french fries taro showed the value of texture mouthfeel is highest french fries taro with immersion $NaHCO_3$ 1.5% with a frying pan at a temperature of 170^0C with a value of 4.01, meaning that this sample has a white color grayish most preferred panelist or have the highest score given panelists. While the total value of the lowest average on the texture mouthfeel french fries taro is a sample a3b2 is soaking $NaHCO_3$ 1.5% on the cooking method of drying at a temperature of 70^0C with the average value of 3.91, indicating that the sample a3b2 is a sample of french fries taro most disliked by panelists in terms of grayish white color french fries taro. This is due to the method of frying with a temperature of 170^0C twice gelatinization process more optimally so that the texture is more tender mouthfeel than the drying method that tends to be loud. It is also influenced by immersion $NaHCO_3$ high concentrations so that when frying CO_2 gas to be issued will be more.

Sodium bicarbonate ($NaHCO_3$) is one of the developers of cakes and fried perenyah form of a white powder, when mixed into the dough will produce CO_2 (Winarno, 1992). The greater the concentration of $NaHCO_3$, the more the more CO_2 gas generated in the material when the frying process. These gases which form pores or voids in the material, but because the starch content in the tuber of taro is quite high and the size of the starch granules are very dense so that the texture of french fries were not crispy taro acquired and porosity of not formed and therefore the mean average value scoring for texture mouthfeel can be categorized had rather good value.

Water present in taro when after the frying pan frying deef will be replaced by oil. The water vapor that forms require the channel to get out of the material. If the release of water vapor is hampered in the location experiencing gelatinisasi, then at these locations will form bubbles. When the bubbles containing water vapor is broken because of the tensions that exist, it will be formed holes called pores (Wijajaseputra, 2010).

Table 12. Scoring Taste Test Results French fries taro

treatment	Number
a1b1	4.46
a1b2	4.28
a2b1	4.43
a2b2	4.25
a3b1	4.40
a3b2	4.00

Based on table 12, test scoring for sample number 6 and number 20 panelists panelists with four replications obtained an average value of the attribute of french fries taste taro taro on each treatment is relatively stable.

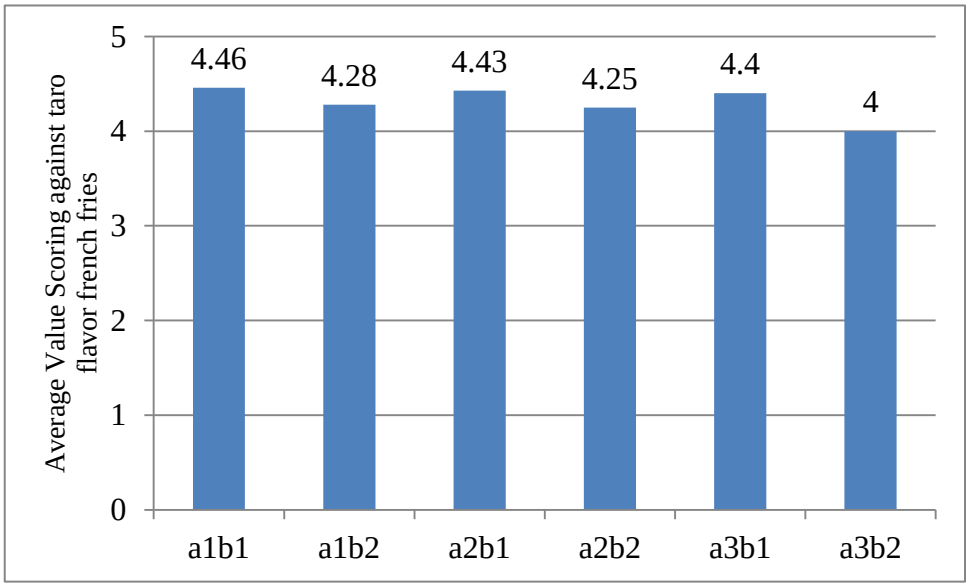

Figure 10. Test Results Scoring Against mouthfeel Textured French Fries Taro

Figure 10 shows the total value of the highest average for the taste of french fries taro is a sample a1b1 is soaking $NaHCO_3$ 0.5% for the cooking method fryer at a temperature of 170^0C with a value of 4:43, meaning that these samples have a sense of the most favored panelist or have the highest score given panelist , While the number of average value low against the taste of french fries taro is a sample a3b2 is soaking $NaHCO_3$ 1.5% on the cooking method of drying at a temperature of 70^0C with the average value of 4.00, it indicates that the sample a3b2 is a sample of french fries taro most disliked by panelists in terms of taro flavor french fries.

The average yield value scoring flavor french fries taro stable at each treatment, it is suspected because of the lack of seasoning are added that cause the characteristic flavor of taro itself still feels though there are various treatment by soaking $NaHCO_3$ and cooking methods are different, so the panelists difficulty in distinguish. This is in accordance with the opinion of Utami (1992), that the advantages of using sodium bicarbonate is french fries do not

affect the taste of taro, taro cheap price of french fries and a high purity level.

Table 13. Results of Sampling Test Scoring for Best French Fries Taro On Top Research

Sample code	Grayish White Color	Texture *Mouthfeel*	Taste *taro*	Number
a1b1	2	1	3	6
a1b2	2	2	1	5
a2b1	2	2	3	7*
a2b2	2	2	1	5
a3b1	1	2	3	6
a3b2	1	1	1	3

Remarks: *) indicates the best sample

Conclusion:

Based on the best organoleptic test sample is a sample a2b1 with $NaHCO_3$ soaking treatment firming agent concentration of 1% with a frying pan at a temperature of 170^0C that have the value / high score.

ANALYSIS OF PHYSICS

Based on the analysis of samples with the best of the organoleptic attributes of grayish-white color, texture, mouthfeel, and a taro flavor is best sample obtained sample a1b2 is soaking firming agent $NaHCO_3$ concentration of 1% with a frying pan at a temperature of 170^0C. The next best samples will be analyzed physics with the goal of measuring the hardness of french fries taro best by using a texture analyzer. The results of the analysis of the best sample a1b2 physics of 4979.99 g force.

Extra reinforcement material (Firming Agent) contribute to improving the robustness of a network of cells, the higher the concentration of the reinforcement material texture french fries produced louder.

This is due to the higher concentration of reinforcement material, the more crosslinking between calcium and pectin are formed so that during further processing of the hardness of the cell wall can be maintained and after experiencing the product will be more crispy frying (Isnaini, et al., 2010).

The addition of sodium bicarbonate tend to reduce the violence is getting crispy sample so samples for moisture content is high enough (Veradila, 2005).

Hardness and softness of materials is closely related to the maturity level of agricultural produce. The materials have a lower maturity level higher hardness (Listanti in Abdillah 2007).

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The results of the research study firming agent concentration and cooking methods on the characteristics of French fries taro as follows:

1. The results of the preliminary study is based on responses using the organoleptic test scoring with a grayish-white color attributes, texture, mouthfeel, and a taro flavor is obtained firming agent selected $NaHCO_3$ 1%.
2. Results of treatment taro french fries were soaking in the concentration of firming agent $NaHCO_3$ 0.5%, 1%, and 1.5% by the method of drying at a temperature of 70^0C and frying method at a temperature of 170^0C showed a correlation cooking temperature and the

concentration of $NaHCO^3$ firming agent against moisture reduction indicated by the value of the correlation coefficient (r) of linear regression on a combination of each treatment. Correlation coefficient (r) combination of temperature varies with the concentration of $NaHCO_3$ firming agent remains on water content values obtained for all treatments r = 1; and the correlation coefficient (r) a combination of firming agent $NaHCO_3$ concentration that varies with the temperature remained on water content is R70 = -0.15554; R170 = -0.3273. While the influence of the concentration of firming agent interaction $NaHCO_3$ and cooking methods on water content of french fries taro value of 0.05 which showed regression with significant regression coefficient R Square value is 0.86 = 86% means that the model fit is quite good.

3. The results of treatment taro french fries were soaking in the concentration of firming agent $NaHCO_3$ 0.5%, 1%, and 1.5% by the method of drying at a temperature of 70^0C and frying method at a temperature of 170^0C showed a correlation cooking temperature and the concentration of $NaHCO_3$ firming agent to decrease blood sugar levels total indicated by the value of the correlation coefficient (r) of linear regression on a combination of each treatment. Correlation coefficient (r) combination of temperature varies with the concentration of $NaHCO_3$ firming agent remains on the total sugar is $r_{0.5}$ = 1; r1 = -1; $R_{1.5}$ = 1; and the correlation coefficient (r) a combination of firming agent $NaHCO_3$ concentration that varies with the temperature stays the total sugar content is R_{70} = 0.9640; R_{170} = 0.8686. While the influence of the concentration of firming agent interaction $NaHCO_3$ and cooking methods of the total sugar content of french fries taro give 0.0597 regression that shows the regression coefficient is not significant to the value of R Square 0.85 = 85% means that the model fit is quite good.

4. Test Results Scoring french fries taro best sample based on attributes of grayish-white color, texture, mouthfeel, and taste of taro is a sample a2b1 is soaking firming agent $NaHCO_3$ 1% with a frying pan at a temperature of 170^0C which has a water content of 18.50%, and the total sugar content amounting to 30.69%.

5. Analysis of samples measuring the hardness of the best physics a2b1 is soaking firming agent $NaHCO_3$ 1% with a frying pan at a temperature of 170^0C using a texture analyzer results obtained 4979.99 g force.

Recommendations

Based on these results, the suggestions can be given that the selection of raw materials to be used in the preparation of french fries should pay attention to the size of the starch granules and the starch contained in the materials will affect the texture of the resulting product in terms of organoleptic, starch content is too high and granule size of the solid as the taro this causes the texture of the products are not good because the porosity is not formed as a result the product is not crunchy. The need for the type of firming agent and a more precise method to open the porosity of taro when will be made french fries.

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