Journal of Vocational Studies on Applied Research

The Effect of Lactic Acid Hydrolysis in the Making of Modified Maizena Flour

Yusuf Arya Yudanto[1*], Raissa Wahyu Alvina[1], Isti Pudjihastuti[1]

[1]Industrial Chemical Engineering, Vocational School, Diponegoro University, Jalan Prof. Sudarto, Tembalang, Semarang, Central Java 50275

*e-mail: yusufaryay@gmail.com

Abstract - *Flour is a useful agricultural product for various foodstuffs, one type of flour obtained in Indonesia is wheat flour. The need for this flour makes the import number of Indonesia increase, whereas many other plants have great potential to be used as raw material for making flour, such as tubers, taro, corn, and others. However, the content of amino acids and sugar as an energy source in corn is still relatively low. So we need a breakthrough to improve it and can affect the quality of the final product. This experiment focused on the combination of the lactic acid hydrolysis process in addition to UV light on maize starch so that the modified product is expected to have properties that almost the same as flour. There is a variety of changing variables which is the concentration of lactic acid. The number of the concentration that we use for this research is 0.5% (w/v); 1% (w/v); 1.5% (w/v); and 2% (w/v). The score of water content that we get is decreasing. It happened because the lactic acid can weaken hydrogen bonds which causes starch molecular weight to be lower, the structure becomes tenuous and soft, so that more water is evaporated during the oven drying process. Besides, the length of the hydrolysis process also affects the water content of the flour produced, which is soaking time inversely proportional to the water content produced. This happens because the longer the reaction with lactic acid causes the hydrogen bonds in starch to be weak so that the bonds between water molecules with various other components in the material are more easily broken. From the analysis, the best point of the water content and baking expansion is consequently 18.780% and 40%. From 4 concentrations used (0.5%; 1%; 1.5%; and 2%), the lowest concentrations gave the best result, because it got the highest score in the baking expansion. This research result shows that modified starch has a better characteristic than natural starch. The factor that determined the good flour is the rheology characteristic which is the baking expansion.*

Keywords- *flour, modified flour, maize flour, water content, baking expansion, hydrolysis, lactic acid*

Submission: June 10, 2020 Correction: October 19, 2020 Accepted: October 31, 2020

Doi: http://dx.doi.org/10.14710/jvsar.v2i2.8107

[How to cite this article: Yudanto, Y.A., Alvina, R.W., Pudjihastuti, I. (2020). The Effect of Lactic Acid Hydrolysis in the Making of Modified Maizena Flour. *Journal of Vocational Studies on Applied Research*, 2(2), 16-19. DOI: http://dx.doi.org/10.14710/jvsar.v2i2.8107]

1. Introduction

Flour is one of an agricultural product that is useful for various foodstuffs, one kind of flour that dominates in Indonesia is wheat flour. The number of imports for wheat flour is increased because of the needs as the population grows, whereas the other plants had great potential to be used as raw material for making flour such as tubers, taro, corn, and many more. Corn is one of the important crops, whose production has continued to increase in recent years [1]. Corn ranks third after wheat and rice as staples in the world, in Indonesia itself, corn is the second most important food crop commodity after rice. However, the content of amino acids and sugar as an energy source in corn is relatively low. So we need a breakthrough to improve it and can affect the quality of the final product. Corn can be used as an alternative to reduce import procurement and can develop a food diversification program in Indonesia. This program has been launched since 1974, but until now it hasn't been running well. Therefore, efforts are needed to find the solutions that can bring non-wheat carbohydrate sources into one alternative food supplement for wheat flout and support the diversification program.

Modification in flour is a starch modification which is the most component available in flour [2]. Besides the diversity of functional properties from starch sources, modification can be used as an alternative to overcome the weaknesses of starch and produce starch with better and specific properties [3]. This word of modification in starch means a change in the molecular structure of starch that can be done chemically, physically, or enzymatically [4]. Modification in a chemical way can be done by adding

certain reagents or chemicals to replace the hydroxyl group (OH^-) in starch [5]. The principle of modification is by hydrolyzing the starch components contained in the flour using acids under gelatinization temperature [3].

Acid hydrolysis can also be known as non-enzymatic hydrolysis uses acids as the catalyst, such as chloride acid. The hydrolysis usually uses a high temperature of 140°C until 160°C [6], [7]. The aim of this research are: (1) to study the process of the modified flour using hydrolysis; and (2) to analyze the effect of lactic acid and UV light irradiation on the product.

2. Methodology

2.1. Materials

In this research, the main material that we use is a commercial product of maize flour from Supermarket. The supportive material for this research are: (1) lactic acid 88% that already purchased from PT Multi Kimia Raya Nusantara Semarang; and (2) aquadest.

2.2. Methods

The operating variables during the research consisted of control variables and independent variables.

Control Variables

The control variables are: (1) the mass of commercial maize flour in the amount of 500 grams; and (2) the duration of irradiation from UV light that is 10 minutes.

Independent Variables

The independent variable is the concentration of lactic acid for hydrolysis (0.5, 1, 1.5, and 2% (w/v) in 1000 mL aquadest).

Experimental Process

Measure the commercial product of maize flour and pour it into a beaker glass that is already filled in by a solution of lactic acid in various concentrations. Then stir it with a magnetic stirrer in the time of 10 minutes with irradiation of UV light. After that, drain and dry in the sun to dry. Then, put the dried mixture into the grinder to make the screening process easily and pour the powder into the vibrating screen with the number of the mesh is 100. The last step is to analyze the product which includes the content water and baking expansion. The product with the best score of water content will be analyzed the value of baking expansion and the score of crispness with the organoleptic test by making it a pilus.

3. Results and Discussion

3.1. Effect of Lactic Acid Concentration on the Value of Water Content

The process of hydrolysis of maize flour with lactic acid and UV irradiation is carried out under constant operating conditions for irradiation time with UV light for 10 minutes with different concentrations of lactic acid concentrations of 0.5% (w/v), 1% (w/v) , 1.5% (w/v), and 2% (w/v). Then the cornflour results are dried in the sun to dry. After that, the results of cornstarch are grinding using a grinder to make the screening process easy. The screening process was carried out on a vibrating screen with a mesh number of 100 mesh. Afterward, the water content will be analyzed, the results of which are shown in Table 1.

Table 1. Observation Result of The Water Content and Baking Expansion

Run	Concentrate (% w/v)	Water Content (%)	Baking Expansion (%)
1	0.5	20	-
2	1	18.780	40
3	1.5	33.458	-
4	2	22.447	-

Figure 1. shows the relationship between the value of water content with the lactic acid concentration that gives fluctuating results. For lactic acid concentrations of 0.5% (w/v); 1% (w/v); 1.5% (w/v); and 2% (w/v) respectively show the water content in the amount of 20%; 18.780%; 33.458%; and 22.474%. The impairment of water content in modified flour is suspected because lactic acid can weaken the hydrogen bonds which causes starch molecular weight to be lower, the structure to be tenuous and soft, so that more water is evaporated during the drying process with an oven [8]. Besides, the time of the hydrolysis process also affects the water content of the flour. This happens because the longer the reaction with lactic acid causes hydrogen bonds in starch to be weak so that the bonds between water molecules with various other components in the material are more easily broken. This breaking also turns out to affect the texture of the material, and the breaking of the bonds of water with other components will make the material porous which makes the evaporation process easier [9].

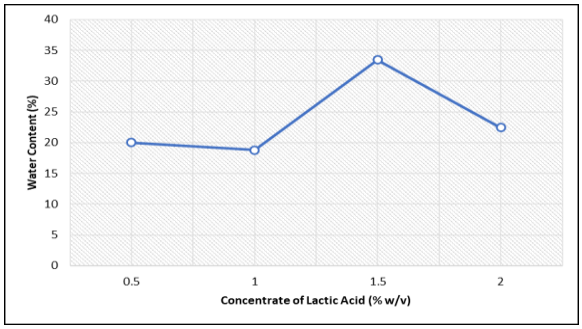

Figure 1. The Relationship betwen Moisture Content and Lactic Acid Concentration

Based on the theory that has been explained by some of the researchers above, it shows that the practicum that we do is not appropriate. This discrepancy is influenced by several factors, including the sample particle size, the position of the sample in the oven, the hydrated compound in the material, and the type of water in the material. Larger samples will cause water to be more difficult to evaporate. The sample will experience concentration on the surface when drying and hardening (case hardening), which will inhibit the release of water from the inside of the sample. Therefore, the size reduction of the sample is

useful for opening pores on the surface of the sample, so that water can escape more easily. Samples that are closer to the heat source will receive heat more quickly which will affect the amount of water evaporated in the sample. Besides, the presence of hydrate compounds that can bind to water (hygroscopic) will make it difficult to evaporate water in the material.

3.2. Effect of Lactic Acid Concentration on the Value of Baking Expansion

The hydrolysis process uses lactic acid with a concentration variation of 0.5% (w/v); 1% (w/v); 1.5% (w/v); and 2% (w/v) and with UV light irradiation for 10 minutes. Each treatment is then dried in the sun to dry. After that, the dried cornstarch turns into a grinding and screening process. Then analyzed the water content and selected the lowest water content to be analyzed the score of the baking expansion. The drying time is directly proportional to the value of baking expansion, which the length of the drying time, will increase the value of baking expansion [10]. Degreated starch caused by lactic acid and UV rays for 10 minutes underwent hydrolysis and drying under the sun showed a maximum value of baking expansion in the amount of 40%. Besides, the higher the concentration of lactic acid, the potential hydrogen value will be smaller [11]. The effect of pH on cornstarch is the addition of a carbonyl group (C-O) and a carboxyl group (C-O-O-H). Both groups are very influential on the viscosity of the paste formed. The group is very influential in the amylose degradation process, so increasing amylose degradation will reduce the paste formed and reduce the value of baking expansion. Besides, the presence of UV light can result in increased formation of carbonyl and carboxyl groups and also decrease starch viscosity [12], [13].

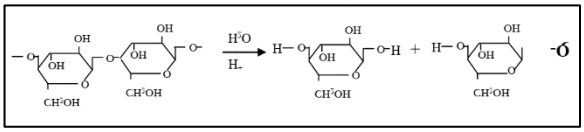

Figure 2. Reaction of Starch Hydrolysis with Acid

3.3. Organoleptic Quality

The organoleptic quality analyzed in this product includes taste, appearance, and crispness. Modified maize flour with the lowest water content values shown in Table 1 made perfectly round pilus dough with a diameter in the amount of 1 cm. Then the dough is fried and produced pilus with a diameter that is more than the previous diameter. Based on panelist ratings in Table 2 products on the 2nd run got the highest score than a commercial product. Data will be more accurate if more panelists assess crispness. Crispness is influenced by the frying method which requires that there be uniform heat exposure with high temperatures which causes the entire surface of the product to transfer heat perfectly [14]. The taste that resulted in modified flour on the 2nd run is better than the commercial product. The appearance of the modified flour, especially the color is more attractive which is golden brown than the commercial product. The modified flour got an average score in the amount of 3.44 on a scale of 4, while the commercial product got an average score in the amount of 1.5 on a scale of 4.

Table 2. Organoleptic Result of The Pilus Made by Modified Flour and Commercial Flour

Parameter	**Modified Product**		
	1st Panelist	2nd Panelist	3rd Panelist
Taste	1	4	4
Appearance	3	4	4
Crispness	3	4	4
Average	**3.44**		
Parameter	Commercial Product		
	1st Panelist	2nd Panelist	3rd Panelist
Taste	1	1	1
Appearance	1	3	2
Crispness	1	2	1.5
Average	**1.5**		

4. Conclusion

The conclusions that can be drawn from this study are as follows:

- The results of the water content analysis showed the lowest value at 2nd run product that is equal to 18.780% with the concentration of lactic acid in the amount of 1% (w/v) and the irradiation time with UV light for 10 minutes. The baking expansion value is 40%.
- The organoleptic quality which includes taste, appearance, and crispiness shows that 2nd run product has better value than a commercial product with values of 3.44 for 2nd run product and 1.5 for a commercial product. This indicates that the addition of lactic acid affects the score of the organoleptic quality of panelists.

5. Acknowledgment

The authors would like to thank the Industrial Chemical Engineering Department of Vocational School in Diponegoro University for facilities to run the research in the laboratory.

References

[1] Badan Pusat Statistik. 2014. Produksi Tanaman Pangan.
[2] R. Mandasari, S. Amanto, and R. A. Achmad. 2015. Kajian Karakteristik Fisik, Kimia, Fisikokimia dan Sensori Tepung Kentang Hitam (Coleus Tuberosus) Termodifikasi Menggunakan Asam Laktat. *Jurnal Teknosains Pangan*. 4(3).
[3] R. Alsuhendra. 2010. Pengaruh Modifikasi secara Pregelatinisasi, Asam, dan Enzimatis Terhadap Sifat Fungsional Tepung Umbi Gembili (*Dioscorea esculenta*). *Prosiding Seminar Nasional FMIPA-UT*, pp. 1–19.
[4] I. Pudjihastuti. 2010. Pengembangan Proses Inovatif Kombinasi Reaksi Hidrolisis Asam dan Reaksi Photokimia UV untuk Produksi Pati Termodifikasi dari Tapioka.
[5] A. Teja, I. Sindi, A. Ayucitra, and L. E. K. Setiawan. 2008. Karakteristik Pati Sagu dengan Metode Modifikasi Asetilasi dan Cross-Linking. *Jurnal Teknik Kimia Indonesia*. 7(3): 836–843.
[6] S. Risnoyatiningsih. 2011. Hidrolisis Pati Ubi Jalar Kuning Menjadi Glukosa secara Enzimatis. *Jurnal Teknik Kimia*. 5(2): 417–424.
[7] S. Koswara. 2009. *Teknologi Modifikasi Pati*
[8] A. R. Ariyantoro and D. Rachmawanti. 2016. Karakteristik Fisikokimia Tepung Koro Pedang (*Canavalia ensiformis*)

Termodifikasi dengan Variasi Konsentrasi Asam Laktat dan Lama Perendaman. *AGRITECH*. 36(1): 1–6.

[9] S. Harijono and M. Erryana. 2008. Detoksifikasi Umbi Gadung (*Dioscorea hispida Dennst*) dengan Pemanasan Terbatas dalam Pengolahan Tepung Gadung," *Jurnal Teknologi Pertanian.*9(2):75–82.

[10] S. Sumardiono and I. Pudjihastuti. 2015. Pengembangan Proses Modifikasi Cassava dengan Hidrolisa Asam Laktat dan UV untuk Substitusi Terigu dalam Produk Pangan. *METANA*. 11(2).

[11] R. P. W. Kesselmans and I. P. Bleeker. 2004. Oxidation of starch. Patent US6822091.

[12] R. E. Harmon, S. K. Gupta, and J. Johnson. 1971. Oxidation of Starch by Hydrogen Peroxide in the Presence of UV Light - Part I. *Starch - Stärke*, 23(10): 347–349.

[13] R. E. Harmon, S. K. Gupta, and J. Johnson. 1972. Oxidation of Starch by Hydrogen Peroxide in the Presence of UV Light-Part II. *Starch - Stärke*. 24(1): 8–11.

[14] I. Pudjihastuti, S. Sumardiono, O. D. Nurhayati, and Y. A. Yudanto. 2019. Perbedaan Metode Penggorengan Terhadap Kualitas Fisik dan Organoleptik Aneka Camilan Sehat. *Prosiding Seminar Nasional Mahasiswa UNIMUS, vol. 2*.