THE PARTIAL CHARATERS OF CHEMICALLY MODIFIED BANANA HUMP STARCH

Rudito[1], Anis Syauqi[1], Ernita Obet[1], Yuli Witono.[2]

[1]Staf Pengajar Politeknik Pertanian Negeri Samarinda
[2]Staf Pengajar Fakultas Teknologi Pertanian Universitas Jember

ABSTRACT

The study of partial characterization of chemically modified banana tuber starch (cross-linking and esterification) has been done. The result showed that the main characters of banana tuber starch are oval-shaped granule, low HCN, reducible water content down to 6%, paste like texture, and good film properties. This makes the starch of banana tuber appropriate as food ingredients. The shapes of banana tuber starches are usually oval and stems. This fact differentiates banana tuber starches with most of starches of tuber granules which are round. Therefore, this singles out the starch of banana tuber as an object of unique and worth of a further studied. The starch of banana tuber has the potency to be developed as precursor or substrate to produce a certain food additives. The process of esterification made starch of banana tuber easier to form gel beside its high viscosities, swelling power and capacity to bond water. Meanwhile, the cross-linking modification can reduce the swelling power and capacity to bond water. The treatment improved viscosity and the geling properties. However, these two modifications techniques are likely to reduce the degree of strach color.

Key words : Banana Tuber Starch, Functionality Starch, Cross-Linking, Esterification

INTRODUCTION

Starch, as a food component, has immense role in determining the food characteristics. Its direct and indirect interactions with other compounds influence the processes, quality and acceptance of food. This is the functional character of starch that comprises gelatinization, retrogradation, solubility, volume expansion, viscosity, etc. These characteristics can be exploited to develop starch as filler, thickening agent, carrier agent, edible film, and texturizer to produce high quality food with the texture and quality demanded by consumers.

Beside cassava, people has been developing other alternative source of starch from *umbi kimpul*, *iles-iles*, *suweg*, *ganyong* and *gadung* tuber. However, because these sources are not available throughout Indonesia, the starch exploration from these sources ends at the extraction process and are limited to laboratory production. It doesn't reach massive production and application phase.

Nowadays, most of starch manufactures rely on one source, cassava. Cassava is considered as a seasonal produce since it is harvested only one time a year. This form of dependency over cassava can results in inefficiency of starch production where cassava is not readily available in times when the starch producers, on the other hand, can still improve the capacity of the equipments to produce starch using the same lay out and systems. With starch source readily available throughout the year and improved capacity of starch equipments, one can double the starch production.

Therefore, it is essential to find alternative source of starch from the local to secure the availability of raw material to be developed into starch with desired functional properties.

Banana tuber is an alternative source of starch. The abundance of banana tuber makes them easily found. Nevertheless, there are limited studies on the utilization of the tuber. Kuswardhani et al. (2002) have found that starch with low Cyanide Acid (HCN) can be extracted from banana tuber. With regard to this finding, a next step to study the potency and utilization of banana tuber starch through characterization and modification of banana tuber starch needs to be done to underpin its production and application in food processing. This study aims to find the partial characteristics of banana tuber starch resulted from chemical modification, cross-linking and esterification.

MATERIAL AND METHODS

The material used in this study is the tuber of *Kepok Banana* from Samarinda, East Kalimantan Province. Meanwhile, most of the chemical substances used in the puree analysis are from Merck, Germany. The main equipments used are pushing micrometer, stainless knives, grater, plastic containers, scales, filter cotton, oven, color reader, oven cup, flour filter, centrifuge, microscope, hot plate, weigh balance bottle, thermometer, Oswald viscometer, and Kjeldahl tube. The expected results, improvement of physico-chemical features and starch functions will be descriptively analyzed. This study tries to chemically modify the features of banana tuber starch. Thus, improve its chemical use to serve as food ingredients. The two modification methods used are the Cross-linking and Esterification.

The method of Cross Linking is carried out by firstly, adding 60 ml into 20 grams of banana tuber starch under the temperature of 35°C. Then NaOH 1 M is added into the solution, before it is stirred until it reached pH of 8. Lastly, 0.15% CH_3COOH was added into it and it is left for 60 minutes. The next step is straining the solution three times. After that, the solution is put under sun or into oven set for 40°C for 24 hours. The last steps are blending and sieving under 100 mesh.

RESULT AND DISCUSSION

Whiteness degree changes

Both methods of modification had significant effect on the whiteness degree of banana tuber. They slightly decreased the whiteness degree, from 72.13 to 71.94. Placing the starch under high temperature (35-40°C) for hours which, led to non enzymatic browning (Maillard) was almost certainly the cause of this fall. The present of non-starch contaminant such as protein, produced the initial dark color. This protein acted as precursor and reacted with carboxyl cluster of total sugar from banana tuber starch, leading to browning.

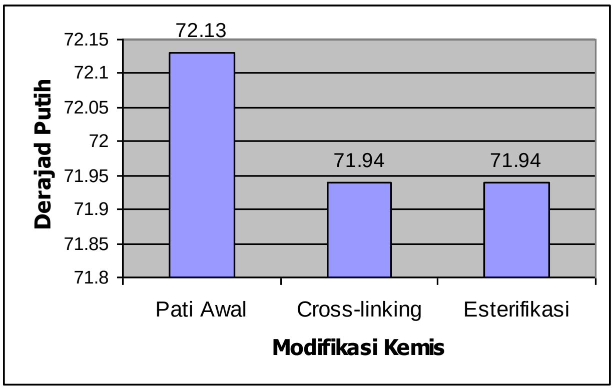

Figure 1. The alteration of whiteness degree of banana tuber starch from chemical modification.

Shape of Granule

The cross-linking modification changes the bonds of starch whereas the esterification breaks some of the starch bonds. These changes alter the distribution of granules. However, the shape of granule does not show any variation or change. Therefore, it is suggested that observation using SEM (scanning electron microscope) needs to be in place to have an in-depth study on the changing of granules shape.

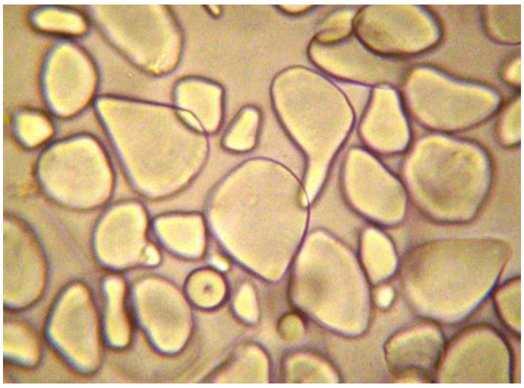

Figure 2. The granule shape of control

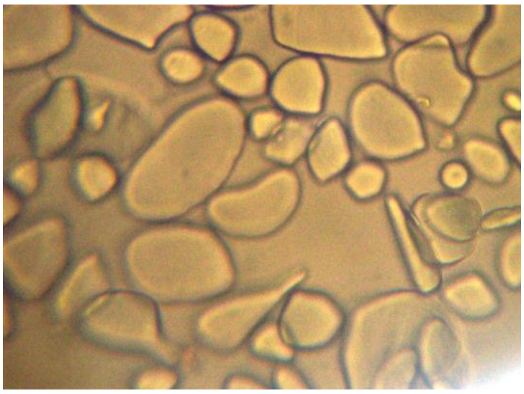

Figure 3. The granule shape after cross-linking modification

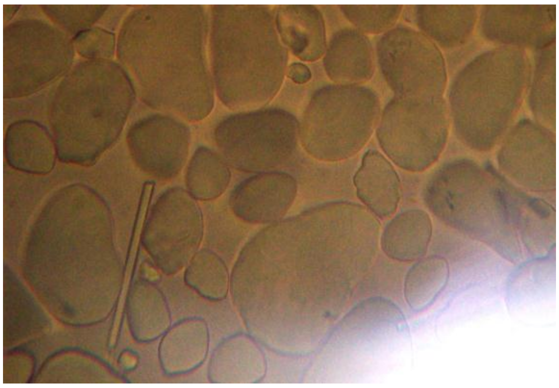

Figure 4. The granule shape after the esterification modification

Ash Content

The cross-linking modification did not have any effect on the ash. On the other hand, esterification significantly decreased the ash content of banana tuber starch. This is shown in Figure 5.

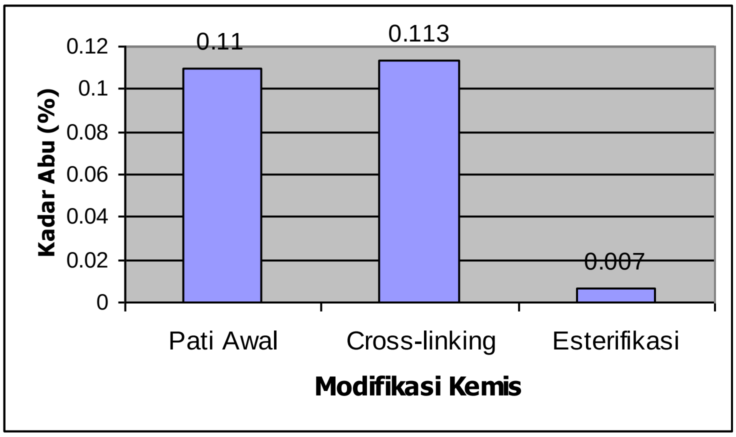

Figure 5. The changes of ash content from banana tuber starch

Temperature of gelatinization

As shown in Figure 6, the two kinds of modifications influenced the gelatinization temperature.

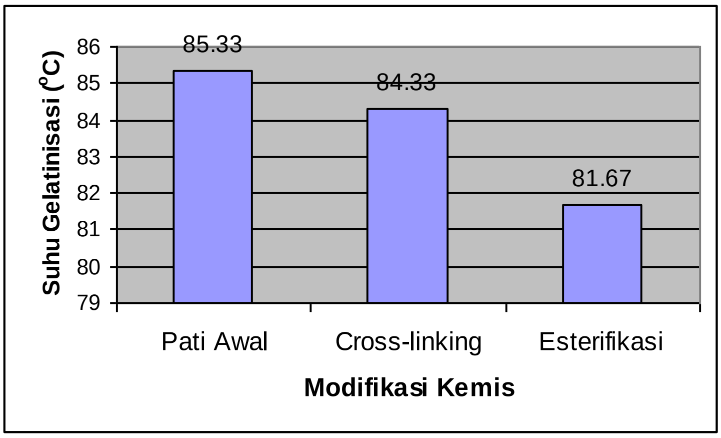

Figure 6. The changes of gelatinization temperature of banana tuber starch

Cross-linking caused the temperature to drop 1 level from 85.33°C to 84.33°C meanwhile esterification decreased the temperature by 4 levels, from 85.33°C to 81.67°C. This means the chemical modifications made the starch granules of banana tuber to form gels more easily and fast.

Viscosity

Cross-linking and esterification had effects on the increase of both hot and cold viscosities of banana tuber starch. This is shown in Figure 7.

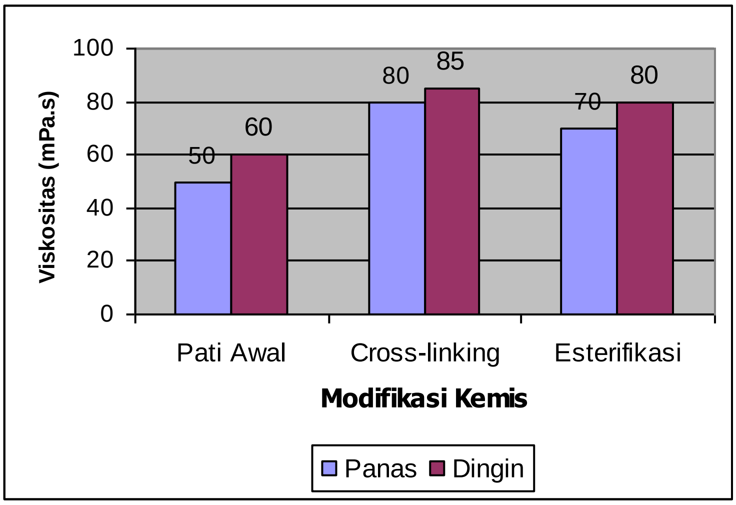

Figure 7. The changes of viscosity of banana tuber starch

The findings of how the cross-linking and esterification change the gelatinization temperature and viscosity serve as interesting basic information in determining the application of starch. Banana tuber starch could form gel more easily only with just a small concentration and it is also high in viscosity. Therefore, banana tuber starch produced by the two modification processes can be used as gelling agent or thickening agent. Nevertheless, it is appropriate to compare these findings with the gelatinization temperature and viscosity from other sources of starch whose functional role on food is well known.

Swelling Power

There was a slight decrease, from 208% to 195.2%, on the swelling power under the cross-linking modification. On the contrary, the esterification enhanced the swelling power by 60%. Figure 8 shows the state of swelling power under each technique of modification.

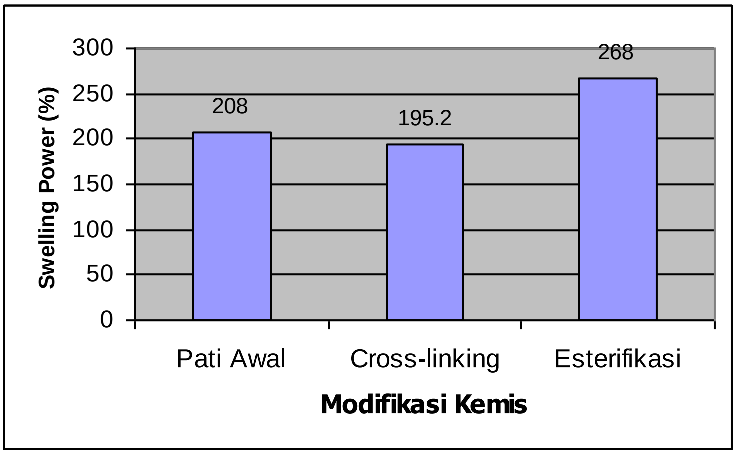

Figure 8. The changing of swelling power of banana tuber starch subsequent to the chemical modification.

The fact that swelling power increased after being modified under esterification indicates a possibility to use banana tuber starch as edible film, gelling agent or thickening agent.

Water Holding Capacity (WHC)

Figure 9 shows the changing of WHC after being modified. Cross-linking brought down the WHC whereas esterification pushed the WHC up from 17.049 to 17.813. In the esterification process, some of the starch glycosidic linkages were hydrolyzed thus reduced the size of starch. Consequently, the number of hydroxyl chains that bind water increased.

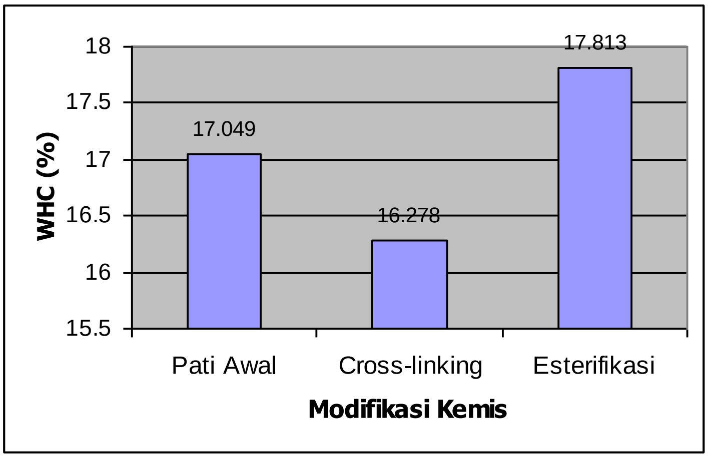

Figure 9. The changing of water holding capacity of banana tuber starch subsequent to the chemical modification.

CONCLUSION AND SUGGESTION

Banana tuber starch is characterized by elliptical-shaped granules, low HCN, water content down to 6%, texture of paste, and good film properties, thus make banana tuber starch relevant for food ingredients. Its granules, elliptical-shaped or bar-shaped, separate it from common granules of potatoes starch which come in round shapes. This distinction makes banana tuber starch more interesting to study the feasibility to develop the potency of banana tuber starch, especially to be precursor or substrate in compounds interactions to produce a particular food additive.

The method of esterification resulted in banana tuber starch with high viscosity, swelling power and water holding capacity. In addition to that, this method makes the starch forms gels more easily. On the other hand, cross-linking method decreased the swelling power and water holding capacity but enhanced viscosity and capacity to form gels. Nevertheless, the two methods tended to reduce the whiteness degree of starch.

Improve the whiteness degree would take more study on the production techniques (pre-treatment) and the modification techniques. Beside that, physical and enzymatic (fermentation) modifications are also encouraged to be done so to produce banana tuber starch with unique characteristic which lead to the increase application of banana tuber starch on food and non-food products. In addition to that, the chemical modification, esterification in particular, can be more improved by examining its reagent composition and the condition of its processes. Another study on the potential of banana tuber starch to be a non-food ingredient for instance, to be the filling agent on tablets, can also be done because the physical properties of banana tuber starch meet the standard of Farmacope Indonesia.

Acknowledgement

Authors would like to thank the Bagian Proyek Peningkatan Penelitian Pendidikan Tinggi, Direktorat Jendral Pendidikan Tinggi, Departmen Pendidikan Nasional R.I. who, through the Program Hibah Bersaing XV, has given finanacial support for this research.

REFERENCES

AOAC. Association Official of Analytical Chemistry. 1997. *Official Methods of Analysis*.

Dufour, D, Larsonneu, S, Alarcon, F, Brabet, C and Chuzel, G. (2002): Improving the bread-making potential of cassava sour starch, *In* Dufour, D., O'Brien, G. M., and Best R.,: *Cassava Flour and Starch: Progress in Research and Development*, International Centre for Tropical Agriculture (CIAT), Columbia.

Fardiaz D. (1992): *Teknik Analisa Sifat Kimia dan Fungsional Komponen Pangan*, Bogor : PAU IPB.

Hoover, R. and Manuel, H. (1995): A Comparative Study of The Physicochemical Properties of Starch from Two Lentil Cultivars. *J. Food Chem*. 53: 275-284.

Muljohardjo M. (1983): *Pengolahan Tapioka*, Jurusan Pengolahan Hasil Pertanian FTP UGM, Yogyakarta.

Kuswardhani, N., Novijanto, N. dan Witono, Y. (2003): Mengkaji Peluang Pemanfaatan Bonggol Pisang sebagai Sumber Pati yang Potensial untuk Pangan, *Prosiding Seminar Nasional Perhimpunan Ahli Teknologi Pangan Indonesia*, Yogyakarta.

Stephen, A.M. (1995): *Food Polysaccharides and Their Applications*. Marcel Dekker, Inc., New York.

Subagio, A., Maryanto dan Windrati, W.S. (2007): *Produksi Sour Starch dari Ubi Jalar menggunakan Bakteri Asam Laktat dan Pemanfaatannya pada Produk Pangan*. Laporan Kemajuan Penelitian-Indofood Riset Nugraha. Jakarta.

Winarno, F.G (1997): *Kimia Pangan dan Gizi*, Gramedia Pustaka Utama, Jakarta.

Wosiacki, G., and Cereda, M. P., (1989): Characterization of pinhao starch. Part III-Hydration of the granules and susceptibility to enzymatic hydrolysis. *Starch/Starke*, 41: 327-330.