

# Modification of Cilembu sweet potato starch with ethanoic acid

A Mahmudatussa'adah\*, Y Rahmawati and Sudewi

Departemen Pendidikan Kesejahteraan Keluarga, Fakultas Pendidikan Teknologi dan Kejuruan, Universitas Pendidikan Indonesia

\*Corresponding author: aims@upi.edu

**Abstract.** Cilembu sweet potato harvest was abundant, its use was still limited. Starch was required by various industries. Starch is generally beige, and requires a long time for the drying process. The purpose of this research was to produce a modified starch with ethanoic acid. The method used in this study was the experimental method. The results showed acid modified starch yield was 18%, with the color characteristics of L\*:  $96.38 \pm 0.82$ ; a\*:  $-0.70 \pm 0.02$ ; b\*:  $2.70 \pm 0.03$ ; C:  $2.79 \pm 0.02$ . Native starch yield was 16%, with the color characteristics of L\*:  $93.55 \pm 0.91$ ; a\*:  $-0.86 \pm 0.06$ ; b\*:  $2.93 \pm 0.04$ ; C:  $3.05 \pm 0.03$ . The conclusion of this study was modified starch of Cilembu sweet potato using ethanoic acid have higher yield and more white bright than native starch.

## 1. Introduction

Starch is a food that is much needed in a variety of industries. Starch can be used as thickeners, binders, fillers, materials for liquid sugar, baby food ingredients, noodles and even material to make ethanol or sizing at the fabric factory. In Indonesia usually starch made from cassava, sago, mung beans, and corn. In China the main ingredient is sweet potato starch maker [1]. Production of sweet potato (*Ipomoea batatas* L) of West Java Indonesia 485 065 tons, with production centers at Garut and Kuningan District [2]. Sweet potato starch contains 50-80% of each sweet potato tubers in dry basis [3].

The process of making the starch is by way of sweet potatoes are cleaned, peeled, grated, added water, squeezed, water and starch suspension is allowed to stand until precipitation of starch, then decanted and the precipitate was dried. Starch yield and color will determine the economic value of the starch. The physicochemical properties of starch largely determine its designation in the industry. Thus in producing or isolating starch often be modified to affect yield, color, and physicochemical properties of starch.

Starch industry in China to make a starch using acid solution, centrifuged, or combine these two techniques. Manufacture of starch using acid solution produces fat, protein, K, P, solubility and L \* higher than using centrifugation and setback, viscosity, lower crystalline [1]. Some previous researchers have used acid solution in the manufacture of starch mungbean [4][5][6], cassava [7], rice [8], corn [9], and sweet potato [1]. Researchers previously used acid solution is fermented a mixture of lactic acid, amino acids, peptides, protein, ash, monosaccharide, oligosaccharide, water and *Lactococcus lactis* bacteria [10]. There are reportedly about sweet potato modified starch manufacture using ethanoic acid. Ethanoic acid is cheap, readily available and food grade.



The purpose of this study was to observe the effect of ethanoic acid in the process of making sweet potato starch to the yield and the resulting color. The yield and the color of starch is important to note the commercialization efforts of sweet potato starch.

## 2. Materials and Methods

Research through the extraction stage, the calculations yield starch and starch color measurement.

### 2.1. Materials

Sweet potato (*Ipomoea batatas* L) Cilembu from the Cilembu village Pamulihan District of Sumedang district West Java Province Indonesia. The planting period of 5 months (November-March 2015), cream skin and yellow flesh. Samples used  $\pm$  100 Kg, good quality with relatively the same weight 150 - 200g. All sweet potatoes washed with running water, drained. Chemicals used ethanoic acid 70% was obtained from the store in the city of Bandung Indonesia.

The tools used scales, knives, a basin, a grater (rasper), abrasion peeler, cabinet dryer, 80 mesh sieve, and oven. Tools for the identification and analysis of the physical, chemical is analytical balance, colorimeter (Minolta CR 310).

Sample preparation

Extraction Starch

Sweet Potatoes washed with running water, abrasion peeler peeled, grated with a grater machines. Results grated fresh water added with a ratio of slurry sweet potato : water is 1: 5, stirred and then filtered using a filter cloth. Suspension (water, starch) allowed to stand 24 hours. Sediment, and the liquid is separated by means of filtered, then the precipitate was dried. Starch sediment ground, then sieved using a 80 mesh sieve. Siftings stored in the dry for further analysis. To make the starch modified with ethanoic acid, is added 5 mL of 70% ethanoic acid into each 1 L suspension of starch.

### 2.2. Analysis Method

#### 2.2.1. Yield (Percent)

The yield of starch is the percentage of starch produced from fresh sweet potato, is calculated by weighing the weight of the starch resulting from the extraction process compared with the weight of fresh sweet potatoes multiplied by 100 percent Water Content [11].

Measurements of water content of flour and water content of fresh sweet potatoes done using the drying method. In this method, the sample is weighed as much as 5 grams, and then inserted into the cup which has been dried beforehand for 2 hours and weighed. The sample is dried in an oven at 110 °C for 24 hours or until dry weights obtained were fixed. Samples removed from the oven and then put in a desiccator until cool, then performed weighing using analytical balance. The water content of the samples was determined using the following formula;

$$\text{The water content (percent bb)} = \frac{(x-y)}{(x-a)} \times 100 \quad (1)$$

Description :

x = weight of dish and sample before drying (g)

y = weight of dish and sample after drying (g)

a = weight of empty cup

Starch levels (AOAC 1995)

Analysis of starch based methods Luff Schrool. Luff Schrool solution was prepared by 25 g CuSO<sub>4</sub>. 5H<sub>2</sub>O dissolved in 50 mL and citric acid in 50 mL of distilled water. A total of 388 g Na<sub>2</sub>CO<sub>3</sub>.10H<sub>2</sub>O dissolved in 400 mL of distilled water. Citric acid solution is added little by little to a solution of soda, then the mixture was added a solution terusi and diluted to 100 ml in volumetric flask. A total of 2 gram sample is introduced into a 500-mL Erlenmeyer, then added 200 mL of HCl 3 percent and the boiling stones. Erlenmeyer mounted on upright coolers and hydrolyzed for 3 hours. The solution is then cooled and neutralized with NaOH to the phenolphthalein indicator. The solution was put in a 500 mL

volumetric flask, in calibration with distilled water, then filtered. A solution of 10 mL pipette into a 250-mL Erlenmeyer and Schroll Luff added a solution of 25 mL and 15 mL of distilled water. Shells made without the sample solution is analyzed. KI was then added a solution of 30 percent and 25 mL of H<sub>2</sub>SO<sub>4</sub> 25 percent. Once the reaction is complete, immediately titrated with Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution until the solution was less colored.

$$\text{starch content (\%)} = \frac{0,9 \times G \times P}{g} \times 100 \quad (2)$$

0.90 = a factor comparison of the molecular weight of the sugar units in the starch molecule

G = glucose equivalent mL Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> used for titration (mg) after sugars calculated

P = dilution

g = weight of sample (mg)

### 2.2.2. Color measurement

The color of the sample was measured with a colorimeter with CIELAB measurement system ([11]Truong et al. 2012). Parameters measured include L\* (Lightness), a\* = red (+) to green (-), b\* = yellow (+) to blue (-). Chromacity (C) shows the intensity of the color which is calculated by the formula  $\sqrt{a^{*2} + b^{*2}}$ . Hue angle (H\*) calculated as  $\tan^{-1}(b^*/a^*)$ . Hue is expressed as degrees angle ranging from 0° - 360°, where 0° (red) in the quadrant + a\*, rotated counter clockwise 90° (yellow) to + b\*, 180° (green) for -a\*, 360° (blue) to -b\*. Colorimeter calibrated with L\* = 92.75, a\* = -0.76, b\* = -0.07. The sample is introduced into a petri dish and carefully pressed surface to remove air bubbles. The color parameter value calculated from the average of three replicates measurements.

## 3. Result and Discussion

The results showed the yield of acid modified starch 18%, with the characteristic color of L\*: 96.38 ± 0.82; a\*: -0.70 ± 0.02; b\*: 2.70 ± 0.03 C: 2.79 ± 0.02. Native starch yield of 16%, with the characteristic color of L\*: 93.55 ± 0.91; a\*: -0.86 ± 0.06; b\*: 2.93 ± 0.04; C\*: 3.05 ± 0.03. The yield of starch with the addition of ethanoic acid in the water for the extraction of starch, higher than without the addition of ethanoic acid. The presence of acid can accelerate the deposition of starch [1]. According to [10][13] in the fermentation of starch suspension under acidic conditions grew dominant lactic acid bacteria is *Lactococcus lactis* and by [4] grew dominant *Streptococcus lactis*. The growth of lactic acid bacteria can change the properties of starch [13]. *Lactococcus lactis* bacteria have the ability to combine the starch granules into groups, so that the starch granule is separated from the protein and fiber. Starch granules flocking accelerate the deposition of starch [14].

Color is an important factor in determining the quality of starch. Starch is expected to have a high rate in the brightness (L\*) and lower in the Chroma (C) [1]. Color affects consumer acceptance of starch [15]. Starch produced by depositing the starch under acidic conditions produces more starch white color L\*: 96.38 ± 0.82, C: 2.79 ± 0.02; compared with no addition ethanoic acid, L\*: 93.55 ± 0.91, C: 3.05 ± 0.03. It can be seen from the figures L\* for the acid modified starch is higher than the number L\* a native starch. Instead number C for the acid modified starch is lower than the number of native starch C. These results similar with the results of the study [1] that made sweet potato starch using acid solution and centrifugation. According to [4][6] mung bean fermented starch under acidic conditions can produce starch that is whiter and better transmission. The fermentation process is expected to change the amorphous starch, thus affecting the physicochemical properties of starch produced. In addition it is estimated the lactic acid can inhibit the activity of peroxidase enzymes, so that the oxidation process of starch is inhibited [6][16][17]. Peroxidase enzyme responsible for the increased rates of chroma or browning.

#### 4. Conclusion

The conclusion of this study was modified Cilembu sweet potato starch using ethanoic acid generating yield and white degrees higher than native starch. The yield of modified starch ethanoic acid 18%, with the characteristic color of L\*:  $96.38 \pm 0.82$ ; a\*:  $-0.70 \pm 0.02$ ; b\*:  $2.70 \pm 0.03$ ; C:  $2.79 \pm 0.02$ . Native starch yield of 16%, with the characteristic color of L\*:  $93.55 \pm 0.91$ ; a\*:  $-0.86 \pm 0.06$ ; b\*:  $2.93 \pm 0.04$ ; C:  $3.05 \pm 0.03$ .

#### Acknowledgements

The authors would like to thank the Directorate General of Higher Education, Ministry of Research Technology and Higher Education, Republic of Indonesia, for funding this research through Hibah Bersaing research grant 2015.

#### References

- [1] Deng, F., Mu, T., Zhang, M. and Oluwaseyi Kemi Abegunde, O.K. 2013. Composition, structure, and physicochemical properties of sweet potato starches isolated by sour liquid processing and centrifugation. *Starch/Stärke* 65: 162–171.
- [2] BPS. 2014. Sweet Potato Production. Central Bureau of Statistics and Director General of Food Crops Production. <http://www.bps.go.id/sector/agri/pangan/table2.shtm>.
- [3] Zhu, F., Yang, X. S., Cai, Y. Z., Bertoft, E., Corke, H. 2011. Physicochemical properties of sweet potato starch. *Starch/Stärke* 63, 249–259.
- [4] Liu, W. J., Shen, F. Q., 2007a. Studies on the physicochemical properties of mung bean starch from sour liquid processing centrifugation. *Journal of Food Engineering*, 79: 358–363.
- [5] Li, Z. G., Liu, W. J., Shen, Q., Zheng, W., Tan, B. 2008. Properties qualities of vermicelli made from sour liquid processing centrifugation starch. *Journal of Food Engineering*, 86: 162–166.
- [6] Liu, W. J., Shen, F. Q. 2007b. Structure analysis of mung bean starch from sour liquid processing centrifugation. *Journal of Food Engineering*, 79: 1310–1314.
- [7] Numfor, F. A., Walter, W. M., Jr., Raleigh, S. J. S. 1995. Physicochemical changes in cassava starch and flour associated with fermentation: Effect on textural properties. *Starch/Stärke* 47: 86–91.
- [8] Lu, Z. H., Li, L. T., Cao, W., Li, Z. G., Tatsumi, E., 2003. Influence of spontaneous fermentation on physicochemical characteristics of rice noodles. *International Journal of Food Science and Technology*. 38: 505–510.
- [9] Yuan, M. L., Lu, Z. H., Cheng, Y. Q., Li, L. T. 2008. Effect of spontaneous fermentation on the physical properties of corn starch rheological characteristics of corn starch noodle. *Journal of Food Engineering*. 85: 12–17.
- [10] Liu, W. J. 2006. Studies on the mechanism of the mung bean starch agglutination by sour liquid and comparison of physicochemical properties of starch and vermicelli. Master Thesis. The Agriculture University of China, Beijing, China.
- [11] AOAC. 1995. Official Methods of Analysis of the Association of Analytical Chemists, Washington D.C.
- [12] Truong, V.D., Hua, Z., Thompson, R.L., Yencho, G.C., dan Pecota, K.V. 2012. Pressurized liquid extraction and quantification of anthocyanins in purple-fleshed sweet potato genotypes. *Journal of Food Composition and Analysis* 26 : 96–103.
- [13] Gao, Q. Y. 1998. Systematic studies on properties of bean starches their application for starch silk, Ph. D. Thesis. South China University of Technology, China.
- [14] Zhang, L. L., Xue, H., Li, X. H. 2010. Study on flocculating activity of the microorganisms in sweet potato acid steeping liquor. *Sci. Tech. Food Industry* 31, 172–175.
- [15] Galvez, F. C. F., Resurreccion, A. V. A. 1992. Reliability of the focus group technique in determining the quality characteristics of mung bean (*Vigna radiate* (L.) Wilczek) noodles. *Journal of Sensory Studies*, 7: 315–326.
- [16] Qin, L. K., Jiang, P., Zhang, Q., Shen, C. G., Qiu, S. 1997. Study on the effect of preventing

milled and filtered potato liquid from browning by sour liquor which was fermented naturally from pea. *Journal of Food Science*. 18, 32–37.

- [17] Rani, V. S., John, J. K., Moorthy, S. N., Raja, K. C. M. 1998. Effect of pre-treatment of fresh *Amorphophallus paeoniifolius* tubers on the physicochemical properties of starch. *Starch/Stärke*. 50: 72–77.