Wariyah_2021_IOP_Conf._Ser.__Earth_Environ._Sci._653_012047.pdf

IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

The physical properties of dried-*growol* produced with different cassava varieties and fermentation time

To cite this article: Ch Wariyah *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **653** 012047

The physical properties of dried-*growol* produced with different cassava varieties and fermentation time

Ch Wariyah*, Riyanto, B Kanetro, T Windarsih and R N Ardiah

Faculty of Agroindustry, Universitas Mercu Buana Yogyakarta, Jl. Wates Km 10, Yogyakarta 55753 Indonesia

Corresponding author: wariyah@mercubuana-yogya.ac.id

Abstract. *Growol* is a staple food made from cassava and obtained through fermentation process. It is usually produced under 2-3 days fermentation and has been observed to have an intermediate moisture content, so it needs to be dried preserved. The purposed of this study was to evaluate the chemical characteristics of fermented cassava as well as the physical attributes of *dried-growol* produced using different cassava varieties and fermentation time. This study used local cassava varieties: *Martapura*, *Mentega*, *Ketan*, and *Lanting*; while the fermentation durations were 2 and 4 days. Each variety of fermented cassava was analyzed for moisture content, starch, and amylose and then was steamed for 15 minutes. The fresh *growols* were dried at 50°C until the moisture content was approximately 10% and then the dried-*growol*s were determined their texture and color. The results showed that cassava variety and fermentation time affected the chemical properties of the fermented cassava as well as the physical attributes of dried-*growol*. Moreover, the starch content of fermented cassava was found to be between 18.25-34.03% with the highest indicated in *Martapura*; while amylose content was between 7.50-18.30%. *Martapura* was observed to have a bright color and a little hard texture.

1. Introduction

Cassava (*Manihot esculenta* Cranz) is the third source of carbohydrate in Indonesia after rice and maize and this is associated with its 14.33% - 35.93% starch content. The total amount of cassava produced in 2017 was 19.054 tons [1] or at approximately 70.90 kg/person/year while only 2.92 kg/capita/year was consumed. The high carbohydrate content makes cassava an alternative staple food aside from rice in several regions of the country.

Growol is a local staple food processed through several stages such as cassava peeling, slicing, soaking or spontaneous fermentation for 3-4 days, washing and separation of fibers, pressing, milling, and steaming [2]. The cassava is softened at the fermentation stage due to the growth of lactic acid bacteria known as *Lactobacillus plantarum* and *Lactobacillus casei subsp Rhamnosus*. These amylolytic lactic acid bacteria produce extracellular amylase which hydrolyze starch into lactic acid directly during cassava fermentation [3]. Hence, *growol* has beneficial effect to health due to its ability to function as a potential probiotic. However, growol is a food with intermediate moisture content which is easily damaged through the growth of molds; and this means it needs to be preserved by drying [4]. Previous study showed that *growol* had 8 – 10 months shelf life in dry form and has been observed to have a hard-physical texture and different variations of color ranging from white to brownish-yellow which makes the food product less attractive.

IOP Conf. Series: Earth and Environmental Science **653** (2021) 012047 doi:10.1088/1755-1315/653/1/012047

The problem in making growol was that the craftsmen always use various cassava varieties, whereas each cassava variety has different composition and color. Cassava varieties can be distinguished from taste, tuber color, skin color; while based on their color, they can be differentiated into white and slightly white [5]. The dried-*growol* usually have variation in color and texture. Moreover, the fermentation process carried out by *growol* craftsmen generally only takes 2-3 days, while the production of lactic acid bacteria which affects the sour taste and texture of the *growol* produced takes 3-4 days.

This study aim was to evaluate the effect of cassava varieties and fermentation time on the physical properties of dried-*growol* and to determine the appropriate cassava varieties and fermentation time to obtain the optimum product.

2. Materials and methods

2.1 Materials

The materials used in this study were local varieties of cassava obtained from Kalirejo and Hargomulyo villages, Kokap District, Kulon Progo Regency, Special Region of Yogyakarta, Indonesia and which consisted of: *Martapura, Meni*, *Ketan* and *Lanting* varieties. Chemicals procedures of pro analysis qualification from Merck were used to determine the starch and amylose content in the fresh cassava and fermented cassava.

2.2 Equipments

The equipment used includes a set of tools to produce *growol*s: a hydraulic press, a Memmert drying oven, a Model F Lovibond Tintometer for color testing, texture-meter (Test Zwick), UV mini 1240 UV-VIS Spectrophotometer, Ohaus analytical balance (PA224, Ohaus Corporation, USA), and vortex (Maxi Mix II type 37600 mixer).

2.3 Research procedure

A fresh sample of each variety of cassava was analyzed for its moisture content by using the gravimetric static method, direct acid hydrolysis method for starch content [6], and colorimetric method for amylose content [7]. G*rowol* was produced according to the approach used by Wariyah and Luwihana [8] and this involved peeling the cassava, cut into 5 cm pieces, then fermented spontaneously by soaking in water with a cassava/water ratio of 1: 3 and with variations in the fermentation time of cassava: 2 days and 4 days.

The fermented cassava samples were analyzed for their moisture content, starch, and amylose and later cooked by steaming for 15 minutes. This was followed by cooling at room temperature and oven-dried at 50^{0}C to reduce the moisture content to approximately 10-12% (controlled by a moisture tester). The dried-*growol* produced was tested for color and texture.

2.4 Experimental design

This research was conducted using a completely randomized design [9] with the factors of cassava varieties and fermentation time. The difference between treatments was determined by the *F test* and the significant difference between samples were tested by Duncan's Multiples Range Test (DMRT) using SPSS 19.0 for windows program.

3. Results and discussion

3.1 Chemical and physical characteristics of cassava

The cassava varieties used in this study were analyzed for their starch and amylose content. The starch and amylose content of the fresh cassava were presented in Table 1.

IOP Conf. Series: Earth and Environmental Science **653** (2021) 012047 doi:10.1088/1755-1315/653/1/012047

Table 1. Starch and amylose content in cassava

Varieties	Moisture (%wb)*	Starch (%wb)*	Amylose (%wb)*
Martapura	58.64±0.31[a]	27.68±1.21[a]	3.3±0.42[a]
Meni	64.52±0.05[b]	10.71±0.57[b]	9.8±0.57[b]
Ketan	62.58±0.71[c]	13.41±1.24[b]	11.7±0.14[bc]
Lanting	52.68±0.13[d]	16.85±2.35[b]	15.5±1.56[c]

* different superscripts in the same column shows significant difference at α = 0.05

Table 1 show that the starch content of *Martapura, Meni, Ketan*, and *Lanting* varieties were significantly different. This finding was in line with the findings of Susilawati *et al*. [10] that each cassava variety has a different harvest age and composition and this means that they all have different starch content. Ariani *et al*. [5] also showed the starch content in cassavas are between 19.13-24.49% depending on the variety. Furthermore, the amylose levels are also influenced by the variety and this was confirmed with the findings of Noerwijati [11] who mentioned that cassava varieties are classified into low (up to 3.4%) and high amylose levels (up to 19.8%.) Amylose molecule contributes on the hard to soft textural properties of the products depending on the ratio of amylose and amylopectin [12]. *Martapura* variety has low amylose content, while *Meni, Ketan* and *Lanting* have medium amylose. The high amylose/amylopectin ratio, the harder the texture of the product.

The physical differences in the appearance of the cassava used in this study are described in Table 2 and the cassavas figure were shown in Figure 1.

Table 2. Physical Characteristics of Cassava

Varieties	Skin color		Color of tubers	Tuber Shape
	Outer	Inner		
Martapura	Brown	White	White	Long and smooth surface
Meni	Brown	Rosy	White	Long and smooth surface
Ketan	Brown	White	White	Long and smooth surface
Lanting	Brown	White	White	Long and wavy surface

Figure 1. Cassava varieties: 1. *Martapura*, 2. *Meni*, 3. *Ketan*, 4. *Lanting*.

3.2 Chemical content of fermented cassava

The starch and amylose contents of fermented cassava obtained from the analysis are presented in Table 3. Table 3 shows the moisture, starch and amylose content of cassava with different varieties and fermentation time.

The moisture content of the cassavas which were fermented for 4 days were higher than those were fermented for 2 days; except for *Martapura*. Alcázar-Alay and Mireles [13] stated that water absorption in the starch which cause granule swelling depend on the amylopectin content, and swelling capacity of starch is directly associated with the amylopectin content and in fact the amylose acts as a diluent and inhibitor of swelling

The starch and amylose content in fermented cassava were significantly different. According to Putri *et al*. [3], processing of *growol* by soaking cassava for 5 days involved crude starch hydrolysis through fermentation as well as the activities of amylolytic lactic acid bacteria to produce metabolites

IOP Conf. Series: Earth and Environmental Science **653** (2021) 012047 doi:10.1088/1755-1315/653/1/012047

in the form of lactic acid and amylose. This actitivy would change the composition of the cassava especially the starch and amylose content.

Table 3. Starch and amylose content of fermented cassava

Varieties	Fermentation (day)	Water content (%wb)*	Starch (%wb)*	Amylose (%wb)*
Martapura	2	56.75±0.58 ^{a}	34.03±0.19^{a}	18.30±0.99^{a}
	4	52.52±0.29^{b}	30.69±0.06^{ab}	18.20±0.57^{a}
Meni	2	58.16±0.36 ^{acd}	18.25±0.99^{c}	7.50±0.14^{b}
	4	60.35±1.24^{c}	19.87±1.18^{c}	11.40±0.00^{c}
Ketan	2	59.16±0.04^{cd}	20.07±0.64^{c}	8.60±0.28^{a}
	4	58.19±0.58^{acd}	22.66±4.55^{bc}	11.20±0.28^{c}
Lanting	2	55.81±0.11^{a}	25.75±1.21^{abc}	13.30±0.14^{cd}
	4	59.23±0.30^{cd}	20.86±0.41^{c}	13.70±0.14^{d}

* different superscripts in the same column shows significant difference at $\alpha = 0.05$

Table 3 shows that the highest value of starch content indicated in *Martapura* and the lowest in *Meni*. The high starch content was, however, associated with the washing process during the fermentation process which causes the purity of the starch content to increase. This is in line with the findings of Wariyah and Luwihana [14] that the starch content of fermented cassava was higher after washing and this further increases its purity. Meanwhile, the highest amylose content was also showed in *Martapura* with 18.30 ± 0.99% at 2 days and 18.20 ± 0.57% at 4 days fermentation while the lowest was in *Meni* with 7.50 ± 0.14% for 2 days and 11.40 ± 0.00% for 4 days fermentation.

The high amylose content was observed to be due to the high starch content in the variety [10]. The amylose content in cassava variety of *Martapura, Meni*, *Ketan*, and *Lanting* were found to be 3.3±0.42%, 9.8±0.57%, 11.7±0.14%, and 15.5 ± 1.56% respectively. This, therefore, means the chemical and physical composition of the cassava used in this study is significantly different according to the varieties.

3.3 Physical characteristics of dried-growol

3.3.1 Dried-growol texture. The texture of dried-growols were analyzed based on their resistance to force, to rupture and the value of texture was shown in Table 4. Table 4 shows the fermentation time does not have any significant effect on the *growol* texture; while varieties have a substantial influence due to the starch content in the cassava.

Table 4. Texture of dried-growol

Variety	Fermentation (days)	Texture (resistance to force, kg) *
Martapura	2	4.50±0.00^{a}
	4	4.75±0.35^{a}
Meni	2	4.25±0.35^{a}
	4	8.25±0.35^{b}
Ketan	2	7.25±0.35^{b}
	4	7.50±0.71^{b}
Lanting	2	7.00±0.00^{b}
	4	8.50±0.00^{b}

* different superscripts in the same column shows significant difference at $\alpha = 0.05$

The amylose component affected the properties of the gel produced by ensuring it is not sticky and firm [15] and this further causes the texture to be hard based on the retrogradation due to high amylose content. In this study, the hardness of dried- *growol* was lower in *Martapura* variety with high amylose.

IOP Conf. Series: Earth and Environmental Science **653** (2021) 012047 doi:10.1088/1755-1315/653/1/012047

In *growol* processing, each of the fermented cassava was cooked before drying and the cassava starch gelatinized during cooking. This study showed that fresh-*growol* made from cassava with high amylose i.e. *Martapura* had firm structuce, while the low amylose fermented cassava produced sticky texture. Drying of the sticky *growol* resulted in hard texture; whereas the firm one produced brittle dried-*growol*. Therefore, the resistance to force of the dried-*growol* with lower amylose was low.

3.3.2 Dried-growol color. The dried-growols were determined their color based on the red, yellow and brightness. Table 5 shows the dried-growols color.

Table 5. The color of dried-growol

Varieties	Fermentation (days)	*Red**	*Yellow**	*Brightness*
Martapura	2	0.45±0.07^{a}	1.00±0.00^{a}	0.00±0.00
	4	0.45±0.07^{a}	1.00±0.00^{a}	0.00±0.00
Meni	2	0.80±0.00^{b}	3.45±0.07^{c}	0.00±0.00
	4	1.10±0.00^{c}	3.40±0.00^{c}	0.00±0.00
Ketan	2	1.25±0.07^{c}	4.55±0.07^{d}	0.45±0.07
	4	1.20±0.00^{c}	3.45±0.07^{c}	0.00±0.00
Lanting	2	0.50±0.00^{a}	1.50±0.00^{b}	0.30±0,14
	4	0.60±0.00^{a}	1.50±0.14^{b}	0.10±0.00

* different superscripts in the same column shows significant difference at $\alpha = 0.05$

Table 5 shows the highest value for red was indicated in dried-*growol* made from *Ketan* cassava variety, thereby, having the ability to produce a darker color. Moreover, *Ketan* variety also had the highest value for yellow and this means it also has a yellow or brown color. Table 5 further indicates *Ketan* variety cassava with 2 days fermentation also has the highest value for brightness and the dried-*growol* produced from this variety was bright in color. Afrianto and Wariyah [16] found that *Ketan* cassava variety which 2 days fermentation had substantially reduced sugar of 0.02±0.001%(db). According to Gonzalez et al. [17], in cassava chip processing, the more reduction of sugar in the raw cassava, the higher the Maillard reaction between protein and reducing sugar, so that the color is getting brown.

4. Conclusion

The fermentation duration did not have any significant influence while varieties had substantial influence on the texture and color of the dried-*growol*. Moreover, *Martapura* cassava variety was found to have a product with bright yellow color and its texture was little hard than other varieties. Therefore, it was concluded that *Martapura* variety is an appropriate variety for making dried-*growol*.

Acknowledgments

The author appreciates the financial assistance provided by the Ministry of Research and Technology through the 2019 Higher Education Excellence Research grant with Contract Letter No. 227 / SP2H / LT / DRPM / 2019 dated 11 March 2019.

References

[1] Ministry of Agriculture of Republic of Indonesia 2019 *Cassava Production in the last five years* (Jakarta: Ministry of Agriculture of Republic of Indonesia)
[2] Hidayat P 2020 *Kulon Progo Typical Growol, Good Staple Food Alternative for Health* internet: https://www.goodnewsfromindonesia.id/2020/05/30/growol-khas-kulon-progo-alternatif-makanan-pokok-yang-baik-untuk-kesehatan
[3] Putri W D R, Haryadi, Marseno D W and Nur Cahyanto M 2012 *J Agric Tech* **13** 52 – 60
[4] Wariyah Ch, Riyanto and Kanetro B 2019 *Pakistan Journal of Nutrition* **18** 12 1139–44
[5] Ariani L L, Estiasih T and Martati E 2017 *J Agr. Tech.* **18** 2 119–128

[6] AOAC 1990 *Official methods of analysis of the association of official analytical chemists* (Washington, D. C.: Association of Official Analytical Chemists)
[7] Williams P C, Kuzina F D and Hlynka I 1970 *Cereal Chem*. **47** 411–420
[8] Wariyah Ch and Sri Luwihana D 2015 *Proceeding of 1st International Seminar on " Natural Resources Biotechnology : from Local to Global"*, September 8th – 9th (Faculty of Biotechnology, Atmajaya University of Yogyakarta) p 150–156
[9] Gacula, M C and Singh J 1984 *Statistical methods in food and consumer research* (Orlando, San Diego New York, London : Academic Press, Inc.)
[10] Susilawati A, Nurjanah S and Putri S 2008 *J Industrial Tech. and Agric. Products* **13** 59–72
[11] Noerwijati K 2015 *Palawija bulletin* **13** 92–100
[12] Lu S, Cik T, Lii C, Lai P and Chen H 2013 *LWT-J Food Sci. Tech* **54** 224–28
[13] Alcázar-Alay S C and Meireles M A A 2015 *Food Sci.Tech*. **35** 215–236
[14] Wariyah Ch and Sri Luwihana D 2016 *Proceeding International Food Conference 2016 Innovation of Food Technology to Improve food Security and Health*. October 20 – 21, 2016 (Widya Mandala Surabaya Chatolic University, Surabaya – Indonesia) p 84–90
[15] Liu H, Nie Y and Chen H 2014 *Int. J Food Properties* **17** 1439–48
[16] Afrianto S and Wariyah Ch 2020 *Agritech* **40** 251–258
[17] González-Cuello R, Tarón-Dunoyer A and Mercado-Camargo J 2018 *Contemporary Eng. Sci*. **11** 935–940

Wariyah_2021_IOP_Conf._Ser.__Earth_Environ._Sci._653_01...

ORIGINALITY REPORT

20%
SIMILARITY INDEX

PRIMARY SOURCES

1	repository.lppm.unila.ac.id Internet	90 words — 3%
2	es.scribd.com Internet	81 words — 3%
3	Chatarina Wariyah, Riyanto ., Bayu Kanetro. "Effect of Cooling Methods and Drying Temperatures on the Resistant Starch Content and Acceptability of Dried-Growol", Pakistan Journal of Nutrition, 2019 Crossref	75 words — 3%
4	repository.wima.ac.id Internet	44 words — 2%
5	ftb.uajy.ac.id Internet	43 words — 2%
6	jurnal.ugm.ac.id Internet	33 words — 1%
7	academicjournals.org Internet	30 words — 1%
8	E P Tenriawaru, Suharjono, T Ardyati, E Zubaidah. "Diversity and the potency of indigenous bacteria in dengen fruit (Dillenia serrata), passion fruit (Passiflora edulis),	28 words — 1%

and pineapple fruit (Ananas sp.) of South Sulawesi, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021
Crossref

9	de Barros Mesquita, Camila, Magali Leonel, Célia Maria Landi Franco, Sarita Leonel, Emerson Loli Garcia, and Thaís Paes Rodrigues dos Santos. "Characterization of banana starches obtained from cultivars grown in Brazil", International Journal of Biological Macromolecules, 2016. Crossref	23 words — 1%
10	www.scitepress.org Internet	19 words — 1%
11	A. O. OLORUNDA, O. C. AWORH, F. A. NUMFOR. "Technical note: Predicting quality of cassava products with the aid of chemical and rheological properties", International Journal of Food Science & Technology, 2007 Crossref	15 words — 1%
12	e-journal.uajy.ac.id Internet	15 words — 1%
13	repository.ubb.ac.id Internet	14 words — 1%
14	www.degruyter.com Internet	14 words — 1%
15	www.soils.wisc.edu Internet	11 words — < 1%
16	E Guntiyastutik, Sugiarto, A M P Nuhrawangsa. "The effect of additional skim and fermentation time on the amount of lactic acid bacteria and the pH of soyghurt", IOP Conference Series: Earth and Environmental Science, 2020 Crossref	8 words — < 1%

17	digitalcommons.wayne.edu Internet	8 words — < 1%
18	www.tandfonline.com Internet	8 words — < 1%

EXCLUDE QUOTES	OFF	EXCLUDE MATCHES	OFF
EXCLUDE BIBLIOGRAPHY	ON		