Food Research 7 (1) : 230 - 235 (February 2023)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

FULL PAPER

Chemical characterization, total starch, amylose and resistance starch of local cocoyam in Maluku, Indonesia

[1]Lopulalan, C.G.C., [2,*]Marseno, D.W., [2]Marsono, Y. and [2]Pranoto, Y.

[1]*Faculty of Agricultural, Pattimura University, Jl. Mr. Putuhena-Poka, Ambon 97233, Indonesia*
[2]*Food Science Study Program, Faculty of Agricultural Technology, Gadjah Mada University, Jl. Flora, No. 1, Bulaksumur, Yogyakarta 55281, Indonesia*

Article history:
Received: 1 September 2021
Received in revised form: 11 October 2021
Accepted: 21 February 2022
Available Online: 21 February 2022

Keywords:
Cocoyam starch,
Chemical characterization,
Total starch,
Amylose,
Resistant starch

DOI:
https://doi.org/10.26656/fr.2017.7(1).674

Abstract

Tubers are a potential source of carbohydrates due to their high starch composition with various benefits in the food and non-food industry. Meanwhile, cocoyam (*Xanthosoma sagitofollium*) is one of the tubers with high starch potential. Therefore, this study aimed to characterize the chemical properties, total starch, amylose, and resistant starch of local cocoyam from several locations in the Moluccas. These locations include Buru Island, Saparua Island and Saumlaki Island, the three locations are separated by the ocean. The starch was extracted using the wet method while the chemical analysis was carried out on the moisture, ash, fat, protein, phosphorus, and carbohydrate contents, as well as total starch, amylose, and resistant starch. Data were analyzed by means of variance (ANOVA) at = 0.05. The significant difference that occurred was continued with Duncan's test (α = 0.05). The results showed that the three starches were significantly different from one another, which implies that the growing location affected the chemical components, as well as the total starch, and amylose while the resistant starch was not significantly different. Based on the results, the growing locations affect the chemical contents but not the resistant starch.

1. Introduction

Indonesia is a tropical country with high annual agricultural production, meanwhile, this is an important capital in fulfilling domestic food needs. One of the largest food commodities in Indonesia is tubers. Based on data from the Indonesian Ministry of Agriculture (2015), cassava production is approximated to reach 21.8 million tons, sweet potatoes 2.3 million tons and potatoes 1.2 million tons. In addition, the production of taro tubers according to the Central Statistics Agency (2012) is 312.7 thousand tons. Aside from the large production, tubers also have a fairly good nutritional content. Meanwhile, Maluku (Moluccas) is one of the provinces in the eastern part of Indonesia, nicknamed. The thousands of islands are due to the presence of several small islands bordered by the ocean. As an archipelago, Moluccas has very rich natural resources, both on land and in the sea. One of these natural resources is tubers including cassava, sweet potato, taro, cocoyam, Asiatic yam, and others that have not been studied. Cocoyam (*Xanthosoma sagitofollium*) is one of the tubers that thrives in the Moluccas but has not been fully utilized by the community. Meanwhile, it has great potential as a non-rice food source due to the high carbohydrate content with starch being the major component. The conversion of cocoyam tubers into ready-to-use starch is expected to increase the diversity of processed products. Also, it is widely used in the food and pharmaceutical industries for a variety of applications. However, starch is still being imported into Indonesia due to the few numbers of industries that carry out commercial production.

Starch is one of the primary sources of carbohydrates and raw materials in the food, pharmaceutical, and cosmetic industries. It is stored in separate granules, with varying sizes, shapes, morphology, composition, and molecular structure depending on the plant's origin (Sajilata *et al*., 2006). The granule diameter generally ranges from 1 µm - 100 µm, with various regular and irregular shapes, and is distributed singly or in groups (Bertolini, 2010). Furthermore, starch is composed of an amylose straight-chain and amylopectin branched polymer. Generally, it contains 20-30% amylose and 70-80% amylopectin, but in certain varieties, it has high amylopectin such as waxy corn with 98% amylopectin. Information about the chemical composition of starch is

*Corresponding author.
Email: *djagal@ugm.ac.id*

eISSN: 2550-2166 / © 2023 The Authors.
Published by Rynnye Lyan Resources

important as supporting data in development for industrial use. In addition, starch is used as an ingredient in the food and non-food industries such as paper, plastics, adhesives, textiles, agrochemical, and pharmaceutical industries. Starch is widely used in the food industry as an ingredient in processed products (e.g. sauces, soups, snacks, bread) with functions such as gelling, stabilising, thickening, binding, texture modification, as a bulking agent, swelling solubility, colour, and digestibility (Sajilata *et al*., 2006; Awokoya *et al*., 2012; Ashogbon and Akintayo, 2014; Martínez *et al.,* 2019). Besides that, the chemical properties differ based on the variety, growing location, and cultivation system. One of the contents that need to be considered for development is resistant starch given its potential to increase when natural starch is modified. Resistant starch (RS) is the undigested portion in the small intestine but is fermented in the large intestine. Sajilata *et al*. (2006) reported that resistant starch reduces blood sugar levels after eating, acts as a prebiotic, has a hypocholesterolemic effect, inhibits fat accumulation, increases mineral absorption, and has no effect on the appearance, taste, and texture of a processed food product.

Therefore, this study aimed to characterize the chemical properties, total starch, amylose, and resistant starch of local cocoyam originating from several locations in the Moluccas. The selection of sampling locations is based on the position of each location separated by the ocean, so it is suspected that they have different starch characteristics. The results of this study are expected to provide data about the characteristics of the chemical properties of starch, total starch, amylose and resistant starch from cocoyam from three different locations so that it can be used according to the needs of the food industry and other industries.

2. Materials and methods

2.1 Materials

Cocoyam tubers were obtained from three locations in the Moluccas, namely Buru, Saparua, and Saumlaki Island from different gardens. The codes used for the three samples were buru cocoyam starch (PB), porto cocoyam starch (PP), and saumlaki cocoyam starch (PS).

Preanalytical chemicals include distilled water, NaOH, HCl, Iodine solution, acetic acid, ethanol, KOH, amyloglucosidase enzyme (Sigma 10155), pepsin enzyme (Sigma P1700), α-amylase (Sigma A1031 1KU), standard glucose solution. Meanwhile, the tools used include Miyako blender, cabinet dryer, 80 mesh sieve, Pyrex glassware, WNB 14 water bath (Memmert), Centrifuge ((EBA 20, Hettich), oven (UN 55 Memmert), spectrophotometer (UV-VIS GENESYS 10S), pH meter (Ohaus, ST3100-B).

2.2 Cocoyam starch making

Cocoyam starch extraction was carried out by wet methods from Peroni *et al*. (2016) with slight modification. The tubers were peeled, washed with running water, and then cut into smaller sizes using a slice with a thickness of 2 mm. The mucus produced from the tubers was removed by washing with running water until the water becomes clear. Furthermore, the starch was allowed to settle for 8 hrs, while the water was removed and then dried for 6 hrs at 50°C using a cabinet dryer. The dry starch was mashed using a blender, sieved with a size of 80 mesh and then packaged in a plastic bag.

2.3 Variable data

The data obtained include the moisture content using the oven method, the ash content, the fat content using the Soxhlet method, the protein content using the Micro Kjedhal method, the starch content (AOAC, 1990), the carbohydrate content (Apriyantono *et al*., 1989), the phosphorus content using the molybdate-vanadate method (Smith and Caruso, 1964), amylose content (Muchtadi and Sugiyono, 1992), (Direct Acid Hydrolysis Method, AOAC, 1990), and Resistant Starch (Goñi *et al*., 1996).

2.4 Data analysis

The data obtained were analyzed statistically using analysis of variance at a 95% confidence level. When F_{count} is greater than or equal to the F table, the analysis is continued with Duncan's test at a level a = 0,05. Data analysis was carried out using SPSS 20.00 device (software).

3. Results and discussion

3.1 Chemical characterization

The results of the analysis of the chemical characteristics of cocoyam starch from the three research locations can be seen in Table 1. Based on Table 1, the water content of the three cocoyam starches observed ranged from 11.02 – 11.25%, PP and PS were not statistically significantly different but both were significantly different from PB (Figure 1). The moisture content was lower compared to Pérez and Lares (2005) who obtained 13.43 and 14.01%, respectively. However, it is slightly higher than the results of Faridah *et al*. (2014). Several factors that influence the difference in moisture content include the location of growth. The PB cocoyam from Buru Island was located at high altitudes surrounded by large trees (> 20 years old) therefore, the

https://doi.org/10.26656/fr.2017.7(1).674

Table 1. Chemical composition of cocoyam starch from three locations in the Moluccas

Cocoyam starch	Moisture content (%db)	Ash content (%db)	Fat content (%db)	Protein content (%db)	Carbo Content (%)	Phosphorus Content (%)
PB	12.25±0.04[b]	0.63±0.01[a]	0.12±0.01[a]	0.12±0.01[a]	87.10±0.04[a]	2.75±0.03[b]
PP	11.02±0.07[a]	0.42±0.00[a]	0.17±0.00[b]	0.35±0.01[c]	88.04±0.07[c]	2.56±0.00[a]
PS	11.02±0.05[a]	0.41±0.01[b]	0.13±0.01[a]	0.23±0.01[b]	87.99±0.07[b]	2.52±0.00[a]

Values are presented as mean±SD. Values with different superscript within the same row are significantly different ($p<0.05$).

Figure 1. a: buru cocoyam tuber, b: porto cocoyam tuber, c: saumlaki cocoyam tuber.
Source: Lopulalan *et al.* (2021)

humidity is quite high and this affects the moisture content of the material. Furthermore, the ash, fat, and protein contents were lower compared to cocoyam from Venezuela (Lawal, 2004; Pérez and Lares, 2005). For water content, fat content, and ash content, the value of cocoyam starch is similar to that of inhambu (*Dioscorea*) starch. In addition, the results indicate a higher quality and extraction efficiency, that is a high degree of purity (de Souza Silva *et al.,* 2019). Notwithstanding the ash content range meets commercial standards. Ash content in starch tends to be lower than in tuber flour, this is influenced by differences in flour processing and starch. Starch is obtained by extraction and washing repeatedly with water. This causes these minerals to be dissolved in the water and also wasted together dregs. The chemical and mineral components of natural starch depend not only on the botanical source but also on the extraction method. Based on the results, the protein, fat, and ash (mineral) content of cocoyam starch was relatively low, indicating that the wet extraction method used produced high starch content. Cocoyam starch contains high carbohydrates (by difference) ranging from 87-88%. The statistical analysis results showed that the three cocoyams have significantly different carbohydrate contents due to different growing locations. This value is in line with Mweta *et al.* (2010) on several accessions of cocoyam (*Colocasia esculenta*) from Malawi and higher than cassava starch (Dolas *et al.,* 2020). Furthermore, the phosphorus content of PB was significantly different from the other two. The presence of phosphate monoester increases the electrostatic repulsion between molecules and leads to changes in the gelatinization character thereby increasing the brightness and viscosity of the paste (Hizukuri, 1986). Moreover, the high phosphorus content in natural starch is needed in the formation of clear pastes and enhances the stability and strength of gels to function as thickeners, binders, and stabilizers (Nadia *et al*., 2013). The phosphorus value of cocoyam starch was higher than that of corn starch, cassava starch, wheat starch, potato starch and rice starch (Waterschoot *et al.,* 2014). Variations in the composition of these starches are caused by intrinsic differences in the sources (Pérez and Lares, 2005).

3.2 Total starch

Starch is a glucose homopolymer with -glycosidic bonds. The properties of starch depend on the length of the carbon chain, as well as straight or branched molecular chains. Starch content is a complex carbohydrate that is not soluble in water. Cocoyam starch from the three locations was extracted using the wet method and ranged from 86.49 – 88.25% (Figure 2). Statistically, PB was significantly different from PP and PS. Differences in growing location, type of tuber, and post-harvest handling are thought to affect the starch carbohydrate content of each location studied. The content is affected by the harvest time (Faridah *et al*., 2014). In the manufacturing process, the tubers are crushed and sliced to obtain slurry starch. Meanwhile, Pudjiono (1998) in Rahmawati *et al*. (2012), explained that this process is carried out to break down the cell wall, hence, about 70-90% of the starch granules are released. The results obtained when compared to 75% taro starch (Wita *et al*., 2012; Ashogbon and Akintayo, 2014), cocoyam starch 64.64 – 65.40% (Coronell-Tovar *et al*., 2019) were still higher. Based on industrial quality standards, the minimum starch content is 75%, meanwhile, the results obtained ranged from 75 - 80%. Therefore, the results obtained meets the quality standards.

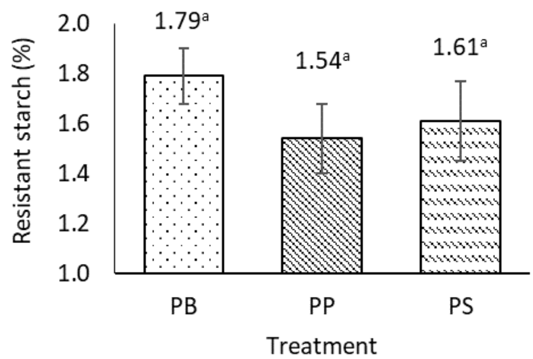

Figure 2. The resistant starch of the three cocoyam starches. Values with different superscript are significantly different ($p<0.05$). PB: Buru cocoyam starch, PP: Porto cocoyam starch, PS: Saumlaki cocoyam starch.

https://doi.org/10.26656/fr.2017.7(1).674

3.3 Amylose

Amylose is part of a straight chain that twists and forms a double tendril region. On the outer surface of the single tendrils, hydrogen is bonded to the O-2 and O-6 atoms. The straight chains of amylose that form the double tendrils of the crystal are resistant to amylase. Furthermore, the inter-and intra-twin hydrogen bonds produce a hydrophobic structure with low solubility. Therefore, amylose single tendrils are similar to cyclodextrins which are hydrophobic on the inner surface (Chaplin, 2002). Based on Figure 3, the amylose content of starch from three locations in the Moluccas was not significantly different from one another. Amylose is very important because it affects paste, gelatinization, retrogradation, swelling power, and digestive enzymes (Gerald *et al*., 2001; You and Izydorczyk, 2002). The values obtained from this study were higher compared to results from Nigeria 22.60% (Ashogbon and Akintayo, 2014), Malawi consisting of 7 accessions of cocoyam ranging from 11.1 – 21% (Mweta *et al*., 2010), and Venezuela 35.34% (Pérez and Lares, 2005). When compared with the results of several tuber varieties in Indonesia, the amylose content of local cocoyam from Moluccas is higher than arrowroot (24.64%) (Faridah *et al*., 2014), Edible canna (Canna) 10.45%, Suweg (*Phallus campanalatus*) 8.38%, Coconut sweet potato (*Dioscorea alata*) 14.10%, and Asiatic yam (*Dioscorea esculenta*) 12.47% (Richana *et al*., 2004). Furthermore, Santacruz (2004), reported that normal starch has an amylose content of 25%.

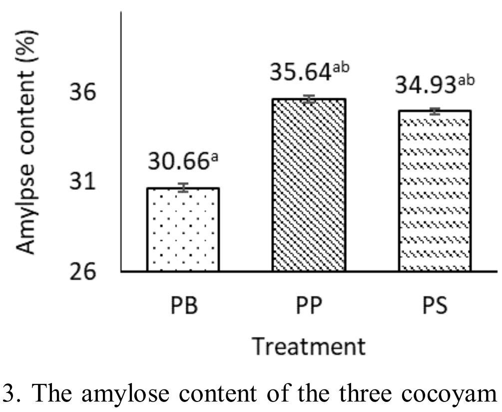

Figure 3. The amylose content of the three cocoyam starches. Values with different superscript are significantly different ($p<0.05$). PB: Buru cocoyam starch, PP: Porto cocoyam starch, PS: Saumlaki cocoyam starch.

3.4 Resistant starch

Undigested carbohydrates found in the human digestive system are called resistant starch and are beneficial for health. Based on the results, the resistant starch from the three locations in the Moluccas was very low, had no significant differences (Figure 4), and was included in type 2. Several factors affect the formation of resistant starch such as the nature of starch, heat and moisture treatment, the interaction of starch with other components of food, processing conditions, heat processing and storage conditions (Sajilata *et al.,* 2006). The granular structure affects the formation of RS. The wide variability in the availability of amylose indicates that raw starch granules also affect the formation of RS (Yuiasari, 2010). The particle size of the starch granules can also affect the resistant starch content. This is in line with the results of research by Lopulalan *et al*. (2021) which resulted in the size of starch particles from three locations having the same size that is suspected to have no significant difference in the RS levels formed. The results obtained were higher than banana starch 1.51% (Aparicio-Saguilán *et al*., 2008), rice 0.85% (Sha *et al*., 2012), but lower than arrowroot starch 2.12% (Faridah *et al*., 2014). Type 2 resistant starch is naturally found in the granule structure, such as uncooked potato, banana flour, and cornflour which contain high amyloses. These granules are resistant to the α-amylase enzyme present in the pancreas. Furthermore, amylopectin levels greatly affect the resistant starch content, the higher the amylopectin level, the harder (resistant) the starch digestion. When compared to the short length of the chain, the straight chain (amylose) has a faster rate of enzyme hydrolysis compared to the branched-chain (amylopectin) (Winarno, 1992). Meanwhile, starch consists of granules and varies in shape and size depending on the source. The physical form is semi-crystalline consisting of crystalline and amorphous units (Jane and Chen, 1992). Hydrolysis by the enzyme alpha-amylase occurs more in the amorphous part, while the crystalline units are more resistant to enzyme treatment due to the presence of strong intermolecular bonds. However, the crystal units are affected by amylopectin, the higher the content, the higher the crystal units (Hoover, 2001).

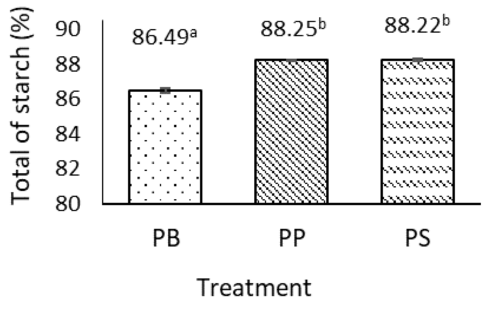

Figure 4. The total starch value of the three cocoyam starches. Values with different superscript are significantly different ($p<0.05$). PB: Buru cocoyam starch, PP: Porto cocoyam starch, PS: Saumlaki cocoyam starch.

4. Conclusion

From the results of this study, it can be concluded that the difference in location even though it is in the same archipelago has an effect on the chemical properties, total starch, amylose content and resistant starch of cocoyam starch.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

This research was funded by the Ministry of Research, Technology, and Higher Education, Republic of Indonesia, through ‘Beasiswa Pendidikan Pascasarjana Dosen dalam Negeril’ (BPPDN).

References

AOAC (Association of Office Analytical Chemist). Official Methods of Analysis. (1990). 15th ed. Vol. 1. Arlington, Virginia, USA: AOAC.

Aparicio-Saguilán, A., Gutiérrez-Meraz, F., García-Suárez, F., Tovar, J. and Bello-Pérez, L.A. (2008). Physicochemical and functional properties of cross-linked banana resistant Starch. Effect of pressure cooking. *Starch - Stärke*, 60(6), 286–291. https://doi.org/10.1002/star.200600584

Apriyantono, A., Fardiaz, D., Puspitasari, N.L., Sedarnawati, S. and Budiyanto. (1989). Analisis Pangan: Petunjuk Laboratorium. Institut Pertanian Bogor, Bandung, Indonesia: Pusat Kegiatan Antar Universitas Pangan dan Gizi,. [In Bahasa Indonesia].

Ashogbon, A.O. (2014). Chemical and functional properties of cocoyam starch and wheat starch blends. *International Journal of Biotechnology and Food Science*, 2(5), 94-101.

Ashogbon, A.O. and Akintayo, E.T. (2014). Recent trend in the physical and chemical modification of starches from different botanical sources: A review. *Starch-Stärke*, 66(1–2),41 57. https://doi.org/10.1002/star.201300106

Awokoya, K.N., Moronkola, B.Ay. and Tovide, O.O. (2012). Characterization of starches from red cocoyam (*colocasia esculenta*) and white cocoyam (*colocasia antiquorum*) cormels. *Food Science and Quality Management,* 5, 27-35

Chaplin, M. (2006). Starch. Retrieved from website: http://www.sbu.ac.uk/starch.

Coronell-Tovar, D.C., Chávez-Jáuregui, R.N., Bosques-Vega, Á. and López-Moreno, M.L. (2019). Characterization of Cocoyam (*Xanthosoma* spp.) Corm Flour from the Nazareno Cultivar. *Food Science and Technology*, 39(2), 349-357. https://doi.org/10.1590/fst.30017

de Souza Silva, G.M., Veloso, C.M., Santos, L. Soares., de Melo Neto, B.A., Fontan, R., da Costa, I. and Bonomo, R.C.F. (2019). Extraction and characterization of native starch obtained from the inhambu tuber. *Journal Food Science Technology*, 57(5), 1830–1839. https://doi.org/10.1007/s13197-019-04216-4

Dolas, K.A., Ranveer, R.C., Tapre, A.R., Nandane, A.S. and Sahoo, A.K. (2020). Effect of starch modification on physico-chemical, functional and structural characterization of cassava starch *(Manihot esculenta* Crantz). *Food Research*, 4(4), 1265 – 1271. https://doi.org/10.26656/fr.2017.4(4).075

Faridah, D.N., Fardiaz, D., Andarwulan, N. and Sunarti, T.C. (2014). Karakteristik sifat fisikokimia pati garut *(Maranta arundinaceae)*. *Agritech*, 34(1), 14-21.

Goñi, I., García-Diz, L., Mañas, E. and Saura-Calixto, F. (1996). Analysis of resistant starch: A method for foods and food products. *Food Chemistry*, 56(4), 445–449. https://doi.org/10.1016/0308-8146(95)00222-7

Hizukuri, S. (1986). Polymodal distribution of the chain lengths of amylopectins, and its significance. *Carbohydrate Research*, 147(2), 342-347. https://doi.org/10.1016/S0008-6215(00)90643-8

Lawal, O. (2004). Composition, physicochemical properties and retrogradation characteristics of native, oxidised, acetylated and acid-thinned new cocoyam (*Xanthosoma sagittifolium*) starch. *Food Chemistry*, 87(2), 205–218. https://doi.org/10.1016/j.foodchem.2003.11.013

Lopulalan, C.G.C., Marseno, D.W., Marsono, Y. and Pranoto, Y. (2021). Karakteristik fisik dan fungsional pati keladi (*Xanthosoma sagittifolium*) dari beberapa lokasi di Maluku *(*Physical and functional characteristic of cocoyam (*Xanthosoma sagittifolium*) starches from some locations in Mollucas. AGRITEKNO*: Jurnal Teknologi Pertanian,* 10(11), 17-23. https://doi.org/10.30598/jagritekno.2021.10.1.17

Martínez, P., Peña, F., Bello-Pérez, A.L., Núñez-Santiago, C., Yee -Madeira, H. and Velezmoro, C. (2019). Physicochemical, functional and morphological characterization of starches isolated from three native potatoes of the Andean region. *Food Chemistry: X,* 2, 100030. https://doi.org/10.1016/j.fochx.2019.100030

Muchtadi, D. dan Sugiyono. (1992). Petunjuk laboratorium ilmu pengetahuan bahan pangan. Jakarta, Indonesia: Institut Pertanian Bogor dan Depdiknas. [In Bahasa Indonesia].

Mweta, D.E., Labuschagne, M.T., Bonnet, S., Swarts, J. and Saka, J.D.K. (2010). Isolation and physicochemical characterisation of starch from cocoyam (*Colocasia esculenta*) grown in Malawi.

FULL PAPER

Journal of the Science of Food and Agriculture, 90 (11), 1886-1896. https://doi.org/10.1002/jsfa.4029

Nadia, L., Wirakartakusumah, M.A., Andarwulan, N. dan Purnomo, E.H. (2013). Karakterisasi Sifat Fisikokimia dan Fungsional Fraksi Pati Uwi Ungu (*Dioscorea Alata*). *Nutrition and Food Research*, 36 (2), 91-102. [In Bahasa Indonesia].

Pérez, E. and Lares, M. (2005). Chemical composition, mineral profile, and functional properties of canna (*Canna edulis*) and arrowroot (*Maranta* spp.) *starches. Plant Foods for Human Nutrition*, 60(3), 113–116. https://doi.org/10.1007/s11130-005-6838-9

Peroni, F.H.G., Rocha, T.S. and Franco, C.M.L. (2006). Some structural and physicochemical characteristics of tuber and roots starches. *Food Science Technology International,* 12(6), 505–513. https://doi.org/10.1177/1082013206073045

Rahmawati, W., Kusumastuti, Y.A. dan Aryanti, D.N. (2012). Karakterisasi pati talas (*colocasia esculenta* (l.) schott) sebagai alternatif sumber pati industri di indonesia. *Jurnal Teknologi Kimia dan Industri*, 1 (1), 347-351. [In Bahasa Indonesia].

Richana, N. dan Sunarti, T.C. (2004). Karakterisasi sifat fisikokimia tepung umbi dan tepung pati dari umbi ganyong, suweg, ubi kelapa, dan gembili. *Jurnal pascapanen*, 1(1), 29-37. [In Bahasa Indonesia].

Sajilata, M.G., Singhal, R.S. and Kulkarni, P.R. (2006). Resistant starch–a review. *Comprehensive reviews in Food Science and Food Safety,* 5(1), 1-17. https://doi.org/10.1111/j.1541-4337.2006.tb00076.x

Sha, X.S., Xiang, Z.J., Bin, L., Jing, L., Bin, Z., Jiao, Y.J. and Kun, S.R. (2012). Preparation and physical characteristics of resistant starch (type 4) in acetylated indica rice. *Food Chemistry*, 134(1), 149–154. https://doi.org/10.1016/j.foodchem.2012.02.081

Waterschoot, J., Gomand, S.V., Fierens, E. and Delcour, J.A. (2014). Production, structure, physicochemical and functional properties of maize, cassava, wheat, potato and rice starches. *Starch/Stärk,* 66, 1–16. https://doi.org/10.1002/star.201300238

Winarno, F. (2008). Kimia pangan dan gizi: Edisi Terbaru. Jakarta, Indonesia: Gramedia Pustaka Utama. [In Bahasa Indonesia].

https://doi.org/10.26656/fr.2017.7(1).674