

The Second International Conference on Genetic Resources and Biotechnology

**Harnessing Technology for Conservation and Sustainable
Use of Genetic Resources for Food and Agriculture**

Bogor, Indonesia • 24–25 May 2021

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Preface: The Second International Conference on Genetic Resources and Biotechnology

The Second International Conference on Genetic Resources and Biotechnology, which is the continuation of the first event held in 2018, focuses on topics related to advances in biotechnology to create more opportunities for effective conservation and sustainable utilization of genetic resources for food and agriculture. This year conference's theme is Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture. The conference was organized by Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Indonesia, in collaboration with Indonesian Biotechnology Consortium and held on 24th-25th of May 2021 virtually due to the pandemic of COVID-19.

The conference aims to share and exchange current scientific information and technological developments on biotechnology and their applications for conservation and sustainable use of genetic, to encourage and promote quality, efficiency, and modernization of management and utilization of genetic resources, and to facilitate national and international collaboration among participants. There are five scopes discussed in this conference. They are effective management of conservation and sustainable use of genetic resources for food and agriculture, application of genomics and molecular markers for genetic resource conservation and crop adaptation to climate change, application of innovative crop improvement techniques for conservation and sustainable use of plant genetic resources for food and agriculture, plant cell and tissue culture for conservation and effective utilization of genetic resources, and the use of microbial genetic resources as biological control agents of agricultural pests and diseases, and for soil bioremediation.

Five speakers from the United States of America, Japan, India and Indonesia were invited to discuss about their expertise and knowledge on relevant subjects in the plenary sessions. This conference was attended by more than 100 participants including 75 presenters and 44 listeners worldwide. They came from diverse governmental, private, or academic institutions and also scientific communities. The presented materials have undergone peer review processes and only qualified papers were selected. Furthermore, all papers were subjected to double blind peer-review and expected to meet the scientific criteria of significance and academic excellence to be published in a conference proceedings indexed in a well-known, reputable service.

We would like to express our sincere gratitude to our speakers, presenters and all participants for their contributions in this conference. We would also like to express our appreciation for the generosity of our sponsors that support this conference: PT CropLife, PT ITS Science Indonesia, PT Fajar Mas Murni and PT Prima Instrument Analitika. Lastly, special thanks to all committee members for their exceptional work and contributions in the conference and publication.

Chair of Organizing Committee

Dr. Toto Hadiarto

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Abstract. Edible canna (*Canna indica* L. syn. *Canna edulis* Ker Gawl.) or Queensland arrowroot is known as underutilized yet functional food due to its excellent eating quality. This plant is harvested as edible starchy rhizome and propagated mostly vegetatively, distinguished by red and green canna for their leaves color. Our previous study found two groups of green canna in IAARD-ICABIOGRAD Gene Bank collection based on their morphological and molecular characters, but their biochemical and physicochemical status, especially on starch content has not been studied yet. This preliminary study aimed to identify starch content in tuber of 13 green canna accessions and to analyze relationship between geographical origin and phenotypic variation on their starch content. As supporting data, water content and dry content were also investigated. Results showed canna tubers from Banyuwangi (accession CI-12) had the highest starch content (15.01%), followed by accessions from Kuningan (CI-08), Bantul (CI-18), and Cilacap (CI-13) with content was >9.5%. High water content (>75%) was found on accessions from Banyumas (CI-09), Bantul (CI-21 and CI-27), Purworejo (CI-14), Kuningan (CI-08), Banyumas (CI-12), and Garut (CI-15). No significant different was observed in starch or water content of respective accessions derived from different origin. Cluster analysis on the respective observation showed two groups of green canna in this study. Further investigation on more accessions or specific starch components were advised to investigate any starch variability to improve utilization of canna as potential food source for health and dietary diversity.

INTRODUCTION

Edible canna (*Canna indica* L. syn. *Canna edulis* Ker Gawl.) is originally from Andean region and grown in many tropical countries including Indonesia. Compared to other starchy sources, edible canna is still underutilized, but later studies on biochemical and biophysical properties showed that edible canna tuber starch has larger granules and higher viscosity compared to other starchy tubers [1–5].

Starch is composed by α -glucose-polysaccharides, amylose, and amylopectin. Amylose and amylopectin proportions is of great importance for starch characteristics. Higher amylose contents increased the rigidity and retrogradation (set back), while high amylopectin correlated with high viscosity and broken down more easily [6]. Higher viscosity, freeze-thaw stability of physicochemical properties, and gelatinization properties also benefits food developer for example as thickening or gelling agent or other food industry [7]. Information on those biophysical and biochemical properties are useful to improve eating quality in term of larger starch granules was easily digested and correlated with infant food [8], lowering blood sugar levels and gut health [9]. Furthermore, enhancement on a broad aspect to utilization of edible canna will promote dietary diversification and the use of starchy-tuber biodiversity to improve nutrition and health.

Edible canna is known as *ganyong* in Indonesia, which is recognized as *ganyong merah* (red canna) and *ganyong hijau* (green canna). A total of 66 accessions of both canna's types are grown and conserved in field collection of IAARD-ICABIOGRAD Gene Bank. Previous morphological and genetic studies [10, 11] showed two clusters of either red canna or green canna were existed in this collections. However, study on biochemical properties, starch

contents and compositions in particular, have not been done on this collections. Therefore, this preliminary study aimed to identify starch content in tuber of 13 green canna accessions and to analyze relationship between geographical origin and phenotypic variation on their starch content. As supporting data, water content and dry content were also investigated.

MATERIALS AND METHODS

Tuber Plant Materials

There were 32 green canna accessions in field collection of IAARD-ICABIOGRAD Gene Bank, which almost half of collections was originally from Central Java, followed by West Java, Special Region of Yogyakarta, and some other province in Indonesia (Table 1). Analysis on their morphological characters have been studied and published. From this previous research, green canna was divided into two groups with a high similarity index [10]. In this preliminary study, 13 green canna accessions from Garut (2 accessions), Kuningan (1 accession), Sukabumi (1 accession), Banyumas (2 accessions), Cilacap (1 accession), Purworejo (2 accessions), Wonosobo (1 accession), and Bantul (3 accessions), were selected to identify total starch content (%), water content (%), and dry content (%) on fresh tubers or rhizomes.

TABLE 1. Geographical origin of 32 green edible canna in the field collection of IAARD-ICABIOGRAD Gene Bank.

No.	Province	Region (number of accessions in the field collection)	Number of accessions in the field collection	Number of accessions in this study
1	West Java	Garut (2), Karawang (2), Kuningan (1), Subang (1), Sukabumi (1)	7	4
2	Central Java	Banyumas (2), Boyolali (1), Cilacap (1), Klaten (4), Kulon Progo (1), Magelang (1), Prambanan (1), Purworejo (3), Wonosobo (1)	15	5
3	Special Region of Yogyakarta	Bantul (3), Yogyakarta (1)	4	3
4	East Java	Banyuwangi (1), Tulungagung (1)	2	-
5	South Sumatera	Musi Banyu Asin (1)	1	-
6	West Nusa Tenggara	Lombok Barat (2)	2	-
7	Central Kalimantan	Kota Waringin Timur (1)	1	-
Total			32	13

Measurement of Starch Content

Starch content was determined by acid starch hydrolysis method [12]. Canna rhizomes were chipped and dried in oven method drying (see procedure for water content below), then crushed into powder (flour). Approximately 5 g samples were put into corning and weighted, then added with 15 ml distilled water. Samples were centrifuged at 3,000 rpm for 15 min. Supernatant were separated with filter paper, washed with distilled water, and made up to 100 ml filtration. Samples were moved to Erlenmeyer flask. About 200 ml distilled water and 20 ml HCl (25%) were added into samples, then autoclaved at 121°C for 15 min.

Samples were left to cool, and 5 drops of phenolphthalein (PP) indicators were added and titrated to neutral with NaOH (45%), made up to 250 ml with distilled water. Samples were filtered and 200-fold dilution of the original sample were made. A 1 ml of sample was removed into test tube, added with 1 ml phenolic acid (5%) and 5 ml sulfuric acid (99%). Samples then heated in water bath at 40°C for 20 min. Sample was transferred to a cuvette. UV-VIS spectrophotometer at 490 nm was used to analyze. Standard curve was plotted between glucose and optical density (OD). Starch content (%) was calculated following the previous mention method [12]:

$$\text{Starch content (\%)} = \frac{K \times L \times 0.9 \times M \times N}{N} \times 100\% \quad (1)$$

where K = sample absorbance (standardized with standard curve), L = sample concentration, M = sample volume (ml), N = sample weight (g), and 0.9 = conversion factor.

Measurement of Water Content and Dry Content

Water content (%) of canna tubers was determined by oven drying method. Fresh chipped samples (3 g) were placed in a drying oven (70°C) for 2 days to remove any free water within the samples. Samples were taken from the drying oven and were cooled in a desiccator, immediately weighted to avoid further dehydration. Estimation of water content (%) was calculated from the following equation:

$$\text{Water content (\%)} = \frac{W_1 - W_2}{W_1} \times 100\% \quad (2)$$

where W_1 = sample weight before oven drying (g) and W_2 = sample weight after oven drying (g). Meanwhile, tuber dry content (%) was calculated by its difference to water content following equation below:

$$\text{Dry content (\%)} = 100\% - \text{water content (\%)} \quad (3)$$

Statistical Analysis

Geographical origin and phenotypic characters were grouped and applied as independent variables in this study. Multivariate general linear model (GLM) was performed to evaluate starch content and water content differences between origins and groups. Hierarchical clustering was applied to classify the accessions. Data was analyzed using IBM SPSS Statistics for Microsoft version 24.0 (IBM Corporation, USA).

RESULTS AND DISCUSSIONS

Green canna accessions were analyzed for their starch content, water content, and dry content. The highest starch content and water content were found on green canna CI-12 accession originated from Banyumas (Central Java), with observed values are 15.01% and 77.34%, respectively (Table 2). Starch content from other regions which was higher than observed mean were obtained on several accessions from Kuningan (CI-08), Bantul (CI-18), and Cilacap (CI-13). While, higher water content was found on accessions from Banyumas (CI-09), Bantul (CI-21 and CI-27), Purworejo (CI-14), Kuningan (CI-08), Banyumas (CI-12), and Garut (CI-15).

TABLE 2. Values of starch content (%), water content (%), and dry content (%) of green canna from different regions and phenotypic grouping.

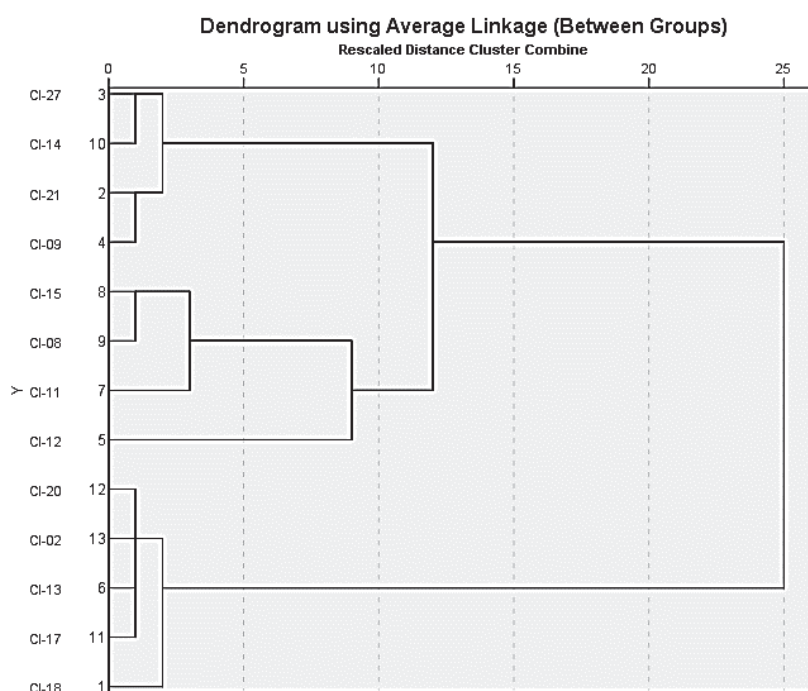
Accession	Origin	Group	Starch content (%)	Water content (%)	Dry content (%)
CI-18	Bantul, Special Region of Yogyakarta	B1	10.00	69.11	30.89
CI-21	Bantul, Special Region of Yogyakarta	B1	7.98	81.16	18.84
CI-27	Bantul, Special Region of Yogyakarta	B1	8.02	79.63	20.37
CI-09	Banyumas, Central Java	B2	9.14	81.33	18.67
CI-12	Banyumas, Central Java	B2	15.01	77.34	22.66
CI-13	Cilacap, Central Java	B1	9.83	71.93	28.07
CI-11	Garut, West Java	B2	9.44	73.65	26.35
CI-15	Garut, West Java	B2	8.54	75.65	24.35
CI-08	Kuningan, West Java	B1	10.33	76.22	23.78
CI-14	Purworejo, Central Java	B1	8.09	79.06	20.94
CI-17	Purworejo, Central Java	B1	8.82	71.52	28.48
CI-20	Sukabumi, West Java	B2	9.00	70.06	29.94
CI-02	Wonosobo, Central Java	B1	8.62	70.77	29.23
Mean average±SE			9.45±0.51	75.19±1.28	24.81±1.28

TABLE 3. Correlation coefficient rate of starch content, water content, and dry content.

Parameter	Starch content	Water content	Dry content
Starch content	1	-0.65	0.65
Water content	-0.65	1	-1**
Dry content	0.65	-1**	1

**Correlation was significant at the 0.01 level (2-tailed).

Clustering analysis was also conducted to classify accessions by the starch content, water content, and dry content. Two main groups of green canna, group A and group B, were found in this study (Fig. 1). Group A was then divided into two other groups, which A1 consist of accessions from Bantul (CI-21 and CI-27), Purworejo (CI-14), and Banyumas (CI-09). While group A2 was consisted of accessions from Garut (CI-11 and CI-15), Kuningan (CI-08), and Banyumas (CI-12). On the other hand, group B was consisted of accessions from Sukabumi (CI-20), Wonosobo (CI-02), Cilacap (CI-13), Purworejo (CI-17), and Bantul (CI-18). Two accessions from Bantul (CI-21 and CI-27) were clustered at the same group (group A), while CI-18 accession was clustered on the other group (group B). Two accessions from Purworejo were also separated into two cluster.

**FIGURE 1.** Dendrogram of 13 accessions of green canna based on starch content, water content, and dry content.

Other studies on canna starch content also showed low variability and no significant difference between Thai, Japanese, and Chinese green or purple canna, about 12.7–13.6% of wet weight basis [14]. No significant difference also found on their starch component, in term of amylose and amylopectin contents [15]. Hung and Morita [5] found that edible canna had the highest amylose content compared to cassava, potato, and sweet potato tubers starch, explained the paste rigidity and a weak resistance against retrogradation (set back) of the canna starch. Further observation on biochemical and physicochemical properties found that canna had the highest the highest set back, the highest final viscosities but the lowest peak viscosity, and the lowest breakdown values compared to other tested starchy tubers [5], thus confirmed the greater gel consistency and stability of canna starch paste at high temperature compared to other tubers.

Other studies did observation on starch component (amylose content) and physical properties (viscosity and starch physicochemical properties), distinguished rice [16] and millet [17] accessions from different region. Andrade-Mahecha *et al.* [18] investigated biochemical and biophysical properties of edible canna collected from Brazil and Colombia, reported significant results from difference native origin. Thus, environment, genetic or

interaction may influence any difference on starch content and compositions in canna. Therefore, observation on the larger accessions and specific identification subjects were suggested to have better insight on relationship between geographical origins and bio-physico-chemical difference in edible canna.

CONCLUSION

Significant difference between starch content, dry content, and water content was not found on group of accessions from different regions in Indonesia. Similar environmental condition during cultivation and small number of accessions tested were suggested as some factors contributing to the low variation in the starch of canna tuber on this study. Further study on starch components, large number of accessions tested, environmental difference, or bio-physico-chemical status of Indonesian edible canna collected directly from the particular region were suggested to investigate the contribution or correlation of biographical origin on canna tuber starch.

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