

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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Screening of Beta Carotene and Its Correlation with Tuber Flesh Color in Sweet Potato

Kristina Dwi Atmini^{a)}, Surya Diantina, Muhamad Sabda and Dodin Koswanudin

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Abstract. Wide range of morphological variation in terms of tuber flesh color in sweet potato (*Ipomoea batatas* [L.] Lam.) varieties or accessions was found in IAARD-ICABIOGRAD Gene Bank collection. The difference in tuber flesh color was mainly attributed to pigmentation. It is known that carotenoids pigment is synthesized in plant organs, including in sweet potato root or tuber. Beta carotene is one of important carotenoid which antioxidant properties are important in human health and nutrition. This study aims to investigate beta carotene content in sweet potato tubers from different accessions and origins. Beta carotene was determined and analyzed with UV-VIS spectrophotometry and two step cluster analysis was applied to group accessions with beta carotene content based on tuber flesh color. Among 40 accessions tested, sweet potato accessions from Garut (West Java), Papua, USA, and Solok (West Sumatera) showed high beta carotene content of 71.3 ppm, 55.5 ppm, 54.8 ppm, and 50.5 ppm, respectively. No significant effect was found between total beta carotenoid content and tuber flesh main color in this study. Result of this study would benefit to provide information in physicochemical characters of some sweet potato accessions.

INTRODUCTION

Carotenoid is a pigment that composed of tetraterpenes of isoprene's units, naturally in red, orange or yellow color that important in physiological functions [1]. Carotene consist of hydrocarbons groups of carotenoid, including α -carotene, β -carotene, β,ψ -carotene (γ -carotene), and lycopene that are found in either photosynthetic or non-photosynthetic organs [2]. β -carotene or beta carotene is considered as an important nutrition in human diet due to its function as the main precursor of retinoid (provitamin A) and antioxidant properties [3]. Beta carotene was mostly found in orange fruits and vegetables, including those orange varieties of sweet potato (*Ipomoea batatas* [L.] Lam.). Sweet potato is usually consumed after cooking process, while the retention of beta carotene content was varied depend on the processing method [4].

Sweet potato together with potato and cassava were grown in tropical to subtropical regions as the world most important tuber crop. Due to its carbohydrate and nutrients sources, sweet potato is a good source of energy with 50% of carbohydrate component is a starch [5]. According to Truong *et al.* [6], regional preference on sweet potato varieties can be described by several groups based on tuber flesh color, dry matter, and texture, such as white-cream tuber flesh with high dry matter and firm after cooking texture are preferred by most tropical consumers. Meanwhile, attractive purple flesh color suits Asian consumers and orange flesh with low dry matter and sweet potato with moist texture after cooking are favored best in the United States.

Indonesia possesses high diversity of sweet potato varieties, mostly characterized by its tuber flesh (storage roots), tuber skin color, and leaves morphologies and genetic [7–9]. IAARD-ICABIOGRAD Gene Bank collects and conserves about 1,350 accessions of sweet potato genetic resources. In regards of tuber flesh color, high morphological variation was found, such as white, cream, various yellow to orange intensity, and purple to dark purple color. This study aims to investigate beta carotene content of 40 sweet potato accessions and determine if any correlation between high beta carotene content and tuber flesh color.

MATERIALS AND METHODS

This study investigated 40 accessions sweet potato tubers obtained from IAARD-ICABIOGRAD Gene Bank collection. Determination on beta carotene content was done at Indonesian Center for Agro Industry (BBIA), Bogor. Beta carotene content was tested *simplo* (without replication) and analyzed with UV-VIS spectrophotometry [10]. Five-gram sweet potato flour was dissolved with 50 ml petroleum ether:acetone acetate (1:1). Solvent was stirred for 10 min and filtered. Ether-carotene phase was collected and added with petroleum-acetone until 50 ml. This mixed solvent was inserted into chromatography column with alumina and Na₂SO₄, then eluate was measured and added with 1.5 ml petroleum-acetone. Absorbance were observed with UV-VIS spectrophotometry at 450 nm wave length and beta carotene content were quantified with linear regression $Y = aX + b$ [10]. Data was analyzed and plotted using SPSS Statistics 24 software. Furthermore, two step cluster analysis was applied to group beta carotene content of 40 sweet potato accessions.

RESULTS AND DISCUSSIONS

Of the 40 sweet potato accessions tested, 15 accessions were from Papua, 9 accessions from East Nusa Tenggara, 6 accessions from West Java, and others were from Bali, Sulawesi, Sumatra, and introduced from USA. Tuber flesh colors were diverse within origin or between origins as shown in Table 1.

TABLE 1. Origin and tuber flesh color of sweet potato obtained from IAARD-ICABIOGRAD Gene Bank collection used in this study.

No.	Origin	Tuber flesh color (number of accessions)	Total number of accessions
1	Manggarai, East Nusa Tenggara	Dark yellow (1)	1
2	East Flores, East Nusa Tenggara	Pale yellow (3), pale orange (2), dark cream (3)	8
3	Karangasem, Bali	Pale yellow (2)	2
4	Gianyar, Bali	Cream (1)	1
5	Jeneponto, South Sulawesi	White (1)	1
6	Magetan, East Java	Pale yellow (1)	1
7	Manokwari, Papua	Pale yellow (3), cream (1), dark yellow (2), intermediate orange (1), white (2)	9
8	Papua	White (1), cream (2), pale yellow (1), dark yellow (1), strongly pigmented with anthocyanin (1)	6
9	North Tapanuli, North Sumatra	Intermediate orange (1)	1
10	Padang, West Sumatra	Dark yellow (1)	1
11	Solok, West Sumatra	Intermediate orange (1)	1
12	Cilacap, Central Java	White (1), dark yellow (1)	2
13	Sukabumi, West Java	Pale yellow (1)	1
14	Garut, West Java	Dark cream (1), dark yellow (1), dark orange (1)	3
15	Karanganyar, Central Java	Cream (1)	1
16	USA	Dark orange (1)	1

Based on beta carotene content, sweet potato accessions in this study were grouped into three clusters with average Silhouette value (measure cohesion and separation) was 0.9 (Fig. 1). The result showed that the first group with majority of accessions tested (80%) had a low beta carotene content (below 10 ppm), 7.5% had medium beta carotene content (10–20%) and 12.5% had high beta carotene content (>38%).

The group of sweet potato accessions with high beta carotene content (>40 ppm) consisted of accessions from five different origins, namely accession 124 from Garut (West Java), accession 582 from Papua, accession 812 from USA, accession 654 from Solok (West Sumatra), and accession 776 from Cilacap (Central Java) with beta carotene contents were 71.3 ppm, 55.5 ppm, 54.8 ppm, 50.5 ppm, and 38.7 ppm, respectively.

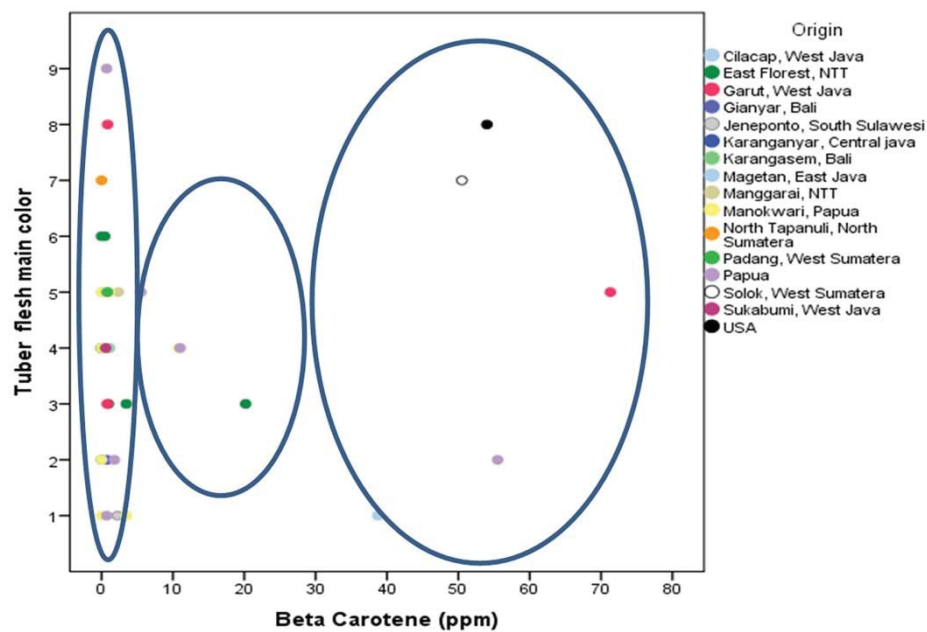


FIGURE 1. Correlation between beta carotene and tuber flesh of sweet potato obtained from IAARD-ICABIOGRAD Gene Bank collection.

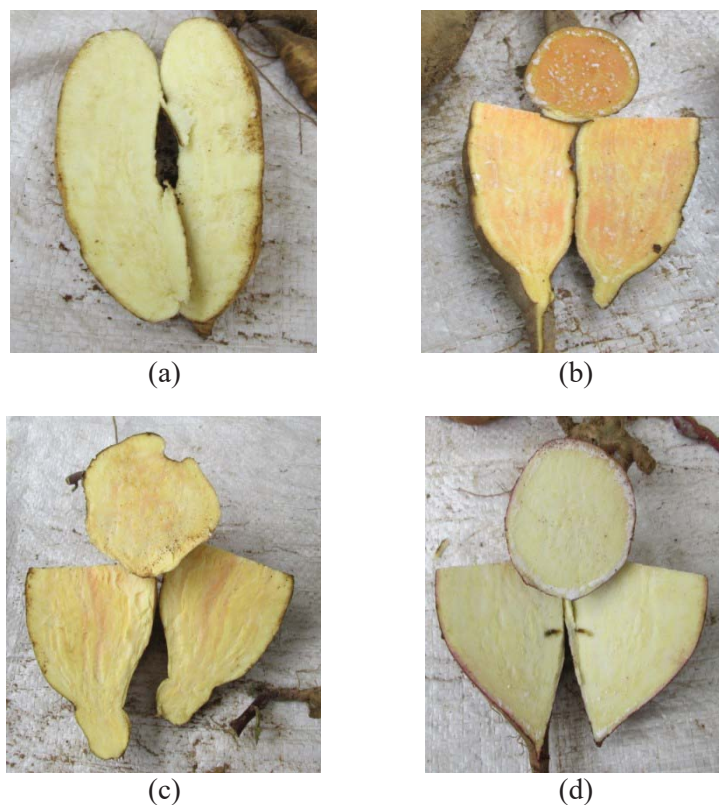


FIGURE 2. Sweet potato tubers with different tuber flesh and beta carotene content. (a) Accession 124 (dark yellow; 71.3 ppm) from Garut (West Java). (b) Accession 812 (dark orange; 54.8 ppm) from USA. (c) Accession 582 (cream; 55.5 ppm) from Papua. (d) Accession 776 (white; 38.7 ppm) from Cilacap (Central Java).

According to Liaaen-Jensen [11] and references therein, the characteristic of polyene chain in carotenoids represent the characteristic colors from colorless (phytoene), yellow (4,4'-diaponeurosporene), orange (b-carotene), red (capsanthin), pink (bacterioruberin), and blue with an increasing number of conjugated double bonds. Albeit orange color indicates carotenoid pigment of beta carotene, ANOVA result on this study showed no significant effect between total beta carotenoid content and tuber flesh main color ($F = 0.581$, $DF = 8$, $p = 0.786$).

Dark orange tuber flesh color did not immediately having higher beta carotene content as showed in Fig. 2. Some studies in the method of beta carotene extraction explained that temperature and extraction method (modifiers) influenced the ratio of cis-beta carotene/total carotenoids [12, 13]. On the other hand, study on anthocyanin content showed positive correlation between anthocyanin and sweet potato tuber flesh color [14], which anthocyanin composition determined the color characteristic [15]. Thus, other factors were suggested to influence tuber flesh color in sweet potato and further research on method development or beta carotene composition is suggested to be investigated.

CONCLUSION

Study of 40 sweet potato accessions showed no significant effect between beta carotene content and origin or tuber flesh color. Most of sweet potato tested have low beta carotene content ($<10\%$), while high beta carotene content was found on dark yellow tuber flesh from Garut (West Java), cream tuber flesh from Papua, dark orange flesh from USA, intermediate orange flesh from Solok (West Sumatera), and white tuber flesh from Cilacap (Central Java) with beta carotene content of 71.3 ppm, 55.5 ppm, 54.8 ppm, 50.5 ppm, and 38.7 ppm, respectively.

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