



Sweetpotato Research Front

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In Celebration of the 20th Issue of the Sweetpotato Research Front (SPORF)

Osamu Yamakawa

Director General of the National Agricultural Research Center for the Kyushu Okinawa Region

The first issue of *Sweetpotato Research Front* was published in December 1995, while I was the chief of the Sweetpotato Lab of KONARC. At that time, there was no worldwide information media available for sweetpotato research. Although only one newsletter on the sweetpotato had been published in the Republic of the Philippines, it was going to be stopped due to a budget deficit. The sweetpotato is one of the world's seven largest crops, but is grown mainly in developing countries. With the exception of Japan, other developed countries are not interested in its research. Japan has conducted many types of research on sweetpotatoes, from breeding to processing. That is why I felt that Japan was the most suitable country for publishing this research information.

Ten years have passed since that time. I am no longer a researcher. When I resigned as editor of SPORF, I was worried about its continued publication. Fortunately, young KONARC researchers have taken over my role, one after

another. From now on, they will be able to produce creative research works, which will be introduced to sweetpotato researchers around the world through SPORF. It is said that the sweetpotato is one of the most promising crops of the 21st century. Japan is ready to use it in many ways for table use, starch, liquor, beverages, flour, coloring material, enzyme material, and many others. I am really happy to see that SPORF is a thriving publication. It will be a useful tool for developing new agribusiness in other countries.



Dr. Yamakawa is the third person on the left side with producers

Research Paper

Healthy Alcoholic Beverage “Pa-Puru” from Purple-Fleshed Sweetpotato

Noriaki Saigusa and Riichiro Ohba

Department of Applied Microbial Technology, Faculty of Biotechnology and Life science, Sojo University

Dr. Riichiro Ohba and his research group in Sojo University have produced an alcoholic beverage, “Pa-Puru,” with a high content of anthocyanin pigment. Pa-Puru was produced from purple-fleshed sweetpotatoes and has been successfully sold since April 2004 (Fig. 1). Since that time, Kumamoto TLO obtained a patent for the beverage-making technique, and the beverage has been manufactured and sold by Chiyonosono Shuzo Co. LTD (Kumamoto, Japan).

Ayamurasaki (*Ipomoea batatas* cv. Ayamurasaki), a newly released cultivar with a high anthocyanin content, was used as the raw material for the beverage developed by KONARC. The Ayamurasaki variety was cultivated in Nishihara Village (Kumamoto, Japan). The production process begins with fermentation of *Rice koji* (*Aspergillus kawachii*) for shochu (a traditional Japanese distilled liquor), wine yeast (*Saccharomyces cerevisiae*), and water. The resultant fermented broth is regarded as *Shubo*. A saccharified mash is made with *Rice koji*, raw Ayamurasaki, and water. The saccharified mash and *Shubo* are then mixed and fermented. When the acidity of the *Rice koji* and the sweetness of the saccharified mash are in harmony, the fermentation broth is filtered, producing a unique and unparalleled fermented alcoholic beverage.

This alcoholic beverage has a wine-like aroma and a brilliant red color that is stable for a long time. *Rice koji* for shochu making produces citric acid, which promotes recovery from fatigue. The purple-fleshed sweet potato, Ayamurasaki, contains an anthocyanin that protects the human body from diseases originating in oxidative stress, such as aging, cancer, and cardiovascular diseases. Figure 2 shows the 1,1-diphenyl-2-picrylhydrazyl (DPPH)-radical-scavenging activity of Pa-Puru and its dose-dependent radical-scavenging activity. Figure 3 shows its antimutagenicity in *Salmonella typhimurium* TA98 using mutagen Trp-P-1. Pa-Puru also inhibited the dose-dependent antimutagenicity induced by Trp-P-1 in *S. typhimurium*. These results suggest that Pa-Puru contributes to good health.



Fig.1. Ayamurasaki and Pa-Puru

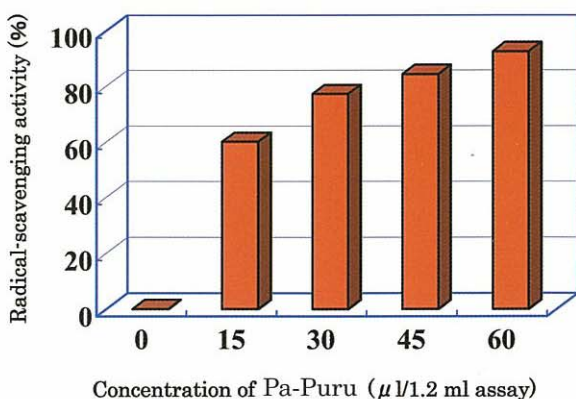


Fig.2. DPPH-radical-scavenging activity of Pa-Puru

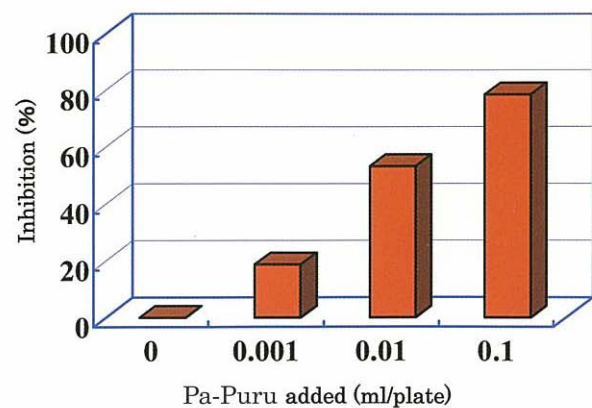


Fig.3. Antimutagenicity of Pa-Puru

Research Paper

New Varieties for Dried Sweetpotato Products Hamakomachi and Kyushu No. 137

Masaru Yoshinaga, Yumi Kai, Kenji Katayama, and Tetsufumi Sakai

Laboratory of Sweetpotato Breeding

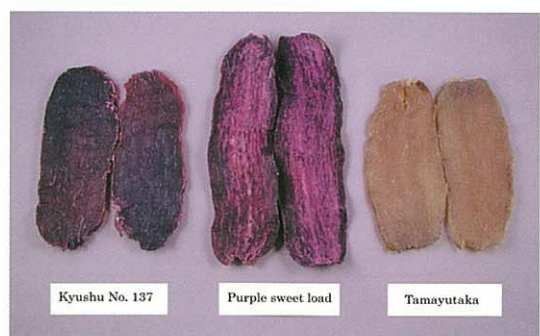
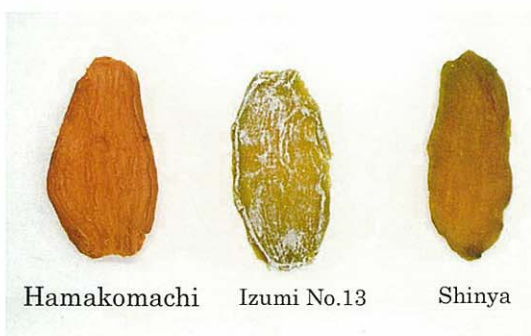
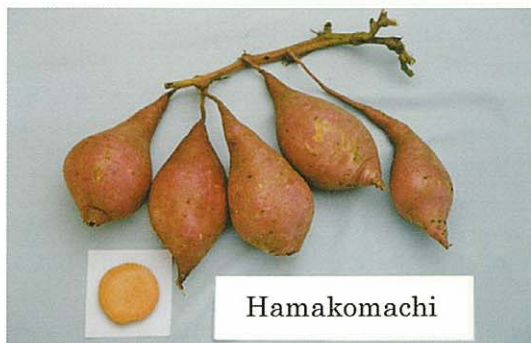
In Japan, dried sweetpotatoes are a traditional staple, prepared by boiling, peeling, slicing, and sun drying. The product has lately been drawing consumer attention as a healthy food. Most of the products are made from the “Tamayutaka” variety, which has white flesh. Cheaper, dried sweetpotato products have recently been imported from China, and they are competing with domestic products. Therefore, we have introduced two varieties to develop colorful new products that enhance their physiological functions to increase the demand for domestic products.

Hamakomachi

This is an orange-fleshed variety released in 2003. It originated from a cross between “Beniotome” and US germplasm “86J-5.” The β -carotene content (44.8mg/100gDW) ranks high among existing orange-fleshed varieties. Its yield is 10% greater than that of “Koganesengan,” which already has a high-yield capability. The color of its dried sweet potato products is deep orange, which is brighter than standard varieties.

Kyushu No. 137

This is a purple-fleshed variety developed in 2004. It originated from a cross between a local, purple-fleshed variety “Tanegashimamurasaki” and “Kyukei No. 165”. It has the same low yield as “Tanegashimamurasaki.” The product’s color, however, is excellent and is a uniform purple. The texture is soft, and superior to that of any other purple-fleshed varieties.



Lutein Content of Sweetpotato Leaves

Koji Ishiguro and Makoto Yoshimoto

Laboratory of Upland Crop Utilization

INTRODUCTION

We have demonstrated that sweetpotato (*Ipomoea batatas*) leaves have a high content of nutrients and polyphenols that perform many physiological functions, such as antioxidant activity and antimutagenicity (1). The new cultivar 'Suioh' was developed to produce useful tops (2) and is used in vegetable juice with high nutritional and polyphenol levels.

Lutein is a member of the xanthophylls family of carotenoids containing vegetables and fruits. Lutein is believed to be beneficial for eye diseases such as age-related macular degeneration (AMD) and cataracts. Green leafy vegetables like spinach and kale contain high levels of lutein (3). This paper demonstrates that sweetpotato leaves have an even greater content of lutein.

RESULTS & DISCUSSION

Lutein content was analyzed according to the HPLC method described by Mizda *et al.* (4). The lutein content of constituent parts of 'Suioh' tops grown in the field in 2003 and 2004 was measured. The average content of the leaves was 36.8mg/100g fresh weight (FW), while the content of the stems and petioles was extremely low in comparison to the leaves (Table). The leaf content was greater than that of *Ipomoea aquatica* leaves (11.9mg/100g FW), and exceeded that of the other fruits and vegetables listed in the carotenoid database of 120 fruits and vegetables generated by Mangels *et al.* (5) (Table).

The changes in lutein content of sweetpotato leaves grown in nursery beds throughout the growing season in 2004 were analyzed, using 13 cultivars or lines. The content declined gradually throughout the Table. Lutein content in constituent parts of sweetpotato ('Suioh') tops grown in the field compared with other vegetables.

	Lutein content (mg/100g FW)	
	Mean (Median)	Min-max
Sweetpotato ('Suioh')		
Leaves	36.8 (37.7)	31.5-42.6
Stems	1.8 (2.2)	0.6-3.0
Petioles	1.6 (2.0)	0.4-2.8
<i>Ipomoea aquatica</i>		
Leaves	11.9 (12.4)	8.5-14.5
Kale ¹	(21.9)	14.7-39.6
Spinach ¹	(10.2)	4.4-15.9
Broccoli ¹	(1.9)	1.8-2.1
Lettuce ¹	(1.8)	—
Peas, green ¹	(1.7)	1.1-2.4

¹ The values of kale, spinach, broccoli, lettuce, and green peas are quoted from the database generated by Mangels *et al.* (5).

growing season, with variation between cultivars. The average content among tested cultivars or lines progressively decreased from 21.8 to 10.0mg/100g FW, while the content in 'Suioh' leaves decreased from 25.7 to 12.9mg/100g FW (Figure). This change might be due to temperature increase during the growing season in this experiment. Alternatively, nutrition deficiency from seed tubers may have caused the decline because of repeated harvesting.

In conclusion, the lutein content in sweetpotato leaves was greater than other vegetables and greater than or equal to kale, although the content varied by harvest date, cultivation conditions, and cultivars. Lutein intake levels of 6-14mg per day have been associated with greater than 50% reduction in risk for AMD and cataracts (3). This level is equivalent to 16.3-38.0g of fresh 'Suioh' leaves grown in fields. Consumption of sweetpotato leaves could help reduce visual dysfunctions in patients suffering from eye diseases. Currently, most of sweetpotato leaves are discarded in fields and nursery beds, but they could be used as material for extraction of lutein as a nutritional supplement.

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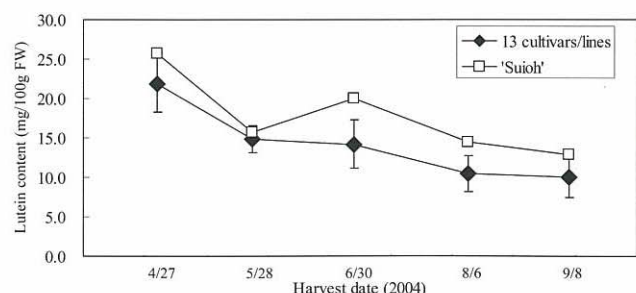


Figure. Changes in lutein contents of sweetpotato leaves grown in nursery beds throughout a growing season.

Research News

Report of the 2nd International Symposium on Sweetpotato & Cassava

Masaru Tanaka

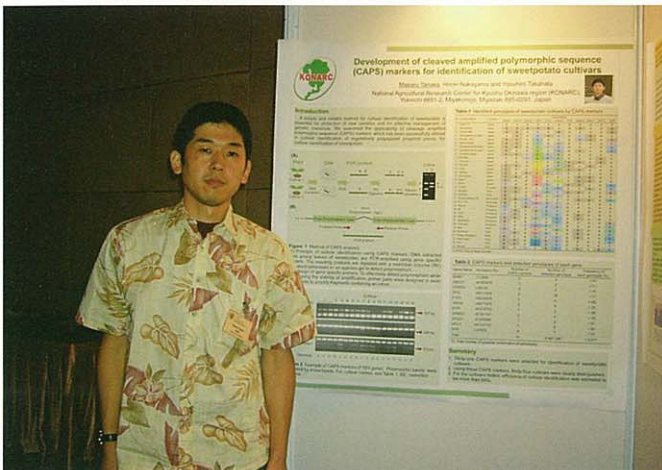
Laboratory of Upland Crop Genetic Resources

The 2nd International Symposium on Sweetpotato & Cassava was held in Kuala Lumpur, Malaysia, from June 14 to 17, 2005. Under the general theme of the symposium, “Innovative Technologies for Commercialization,” there were six specialized sessions: “Success stories in commercialization,” “New varieties for new markets,” “Combating biotic constraints,” “Innovative production systems,” and “Value adding for better health.” Approximately 150 researchers from all over the world participated in the symposium and reported on their recent studies. Our institute, KONARC, presented four topics: “Nutritional value of and product development from sweetpotato leaves” by Dr. Makoto Yoshimoto, “Content of eye-protective lutein in sweetpotato leaves” by Dr. Koji Ishiguro, “Depression of melanin production by sweetpotato leaf polyphenolics” by Dr. Rie Kurata, and “Development of cleaved amplified polymorphic sequence (CAPS) markers for identification of sweetpotato cultivars” by Masaru Tanaka.

Through the symposium, I learned about recent progress in my research field, such as novel attempts

for genetic transformation of sweetpotatoes, evaluation of genetic resources using molecular markers, and the molecular mechanism of secondary metabolite accumulation in storage roots. I was especially impressed by a presentation made by a Brazilian researcher, Dr. Carvalho, in which he analyzed the genetic resources of cassava with different carotenoid composition, using both proteomic and transcriptomic approaches to obtain useful information for improved provitamin A content in storage roots. I believe his approach may be a good model for studying the secondary metabolism of sweetpotatoes.

During the symposium, almost all of the foreign participants stayed in the same hotel and enjoyed communication during breakfast, lunch and dinner. The symposium was an excellent opportunity to build up new collaboration between researchers from different countries, or different research fields. I look forward to the next meeting of this symposium, and I would like to express my thanks to all the symposium staff for their well-ordered management and kind support throughout the symposium.



Reader's Talk

Letter to the editor



Treasure in Trash

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Advanced technology can effectively utilize trash. There can be treasure in such trash, but further study is needed to prove this. However, some people are currently doing this. Around the world, sweetpotato roots are commonly eaten, but there are only a few areas where the tops are eaten. Elderly Japanese people hate the tops of sweetpotatoes because of their previous experience during pre-war food shortages and particularly in post-war Japan. Most have ceased using sweetpotato tops, yet the leaves of the staple sweetpotato can be quite delicious.

I examined the biological functions of the sweetpotato tops and discovered that they produce strong antimutagenicity and DPPH radical scavenging activity. I attempted to separate the components extracted from the sweetpotato tops, but could only isolate the known compounds, flavonoids, chlorogenic acid, and dicaffeoylquinic acids. I could not isolate any unknown compounds, and thus began to lose interest in sweetpotato tops. I was about to give up, so I stopped using

chromatography and concentrated on other work. As time was critical, I threw away the August confirmation of TLC. From a sweetpotato top I found in the trash, I noticed what appeared to be a different compound. I confirmed a small spot and performed instrumental analysis of the compound. From analysis of NMR and MS, I found a known compound, a quinic acid tricaffeate. From shared document retrieval, I confirmed that its anti-HIV activity is of the general strength requested by Prof. Harada of the Kumamoto University AIDS research center, and I examined the activity. This compound can easily be picked up from the trash. Dr. M. Yoshimoto and Dr. O. Yamakawa confirmed other physiological activities of this compound, thus an interesting result soon became another topic.

I have been studying the utilization of *Cylas formicarius*, damaged sweetpotato, quite common in Indonesia in the dry season. We don't usually find a diamond in the trash. However, you may occasionally find one as I have.

Announcement

The 2nd Japan - China - Korea Workshop on Sweetpotato is held on September 13-15, 2006 at Miyakonojo City Gallery in Miyazaki prefecture. The objectives of the workshop are to stimulate future research activities for value-added product development and achievement of environmental-friendly cropping system, and to build a closer relationship for future cooperation among the three nations.

Editor's note

SPORF has been in existence for 10 years, during which time we have dispatched much information about the sweetpotato, from gene resources to processing and utilization. (M.Y.)



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