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Sweetpotato Research Front

National Agricultural Research Center for Kyushu Okinawa Region (KONARC) No.15, February 2003

Contents

Report of the 16th Meeting on Root-Crop Research Held in Saga Prefecture

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Chief of Sweetpotato Breeding Lab. KONARC

The 16th Meeting on Root-Crop Research was held December 5-6, 2002, in Saga Prefecture. Eighty-eight researchers engaged in study of the sweetpotato and the potato attended the meeting to exchange information on results and plans for future studies. The discussions on the sweetpotato and the potatoes are summarized below.

1. Trials of sweetpotatoes conducted by the Prefectural Agricultural Experiment Station for newly distributed breeding lines were described. Kyushu-145 and Kyudhu-146 have a good taste and a good shape, making them suitable for table use. Kyushu-147, with low Brix, was selected for food processing use. Kyushu-148 has a rich anthocyanin content. Kyushu-122, Kyushu-123 and Kyushu-134 will be registered as new varieties.

2. Trials of potatoes conducted by the Prefectural Agricultural Experiment Station for newly distributed breeding lines were described. Saikai-30 was selected for good taste and yield. Saikai-29 will be registered as a new variety.

3. Nine short research topics were presented: 1) Screening methods for high scavenging activity using the spectral characteristic of the extracts; 2) Study of the efficiency by using the DNA marker and the selection for compound resistance to diseases; 3) Characteristics of the new variety of sweetpotato "Suioh"; 4) Labor saving and early handling of sweetpotato using the affixing tunnel mulch; 5) Influence of ground temperature on the growth and yield of the purple potato; 6) Use of biodegradable mulch in the spring potato cultivation; 7) Nematode density after the cropping of the nematode-resistant sweetpotato cultivar; 8) Race of southern root-knot nematode and the nematode resistance of the sweetpotato; and 9) Problem and control of common scab in the Uwaba area, Saga Prefecture.

4. Kazuhiro So, Head researcher of Agricultural Chemicals Laboratory, National Federation of Agricultural Co-operative Associations gave a presentation on the latest trend of the substitutive technology of the methyl bromide.

The next meeting will be held in Kagoshima Prefecture.

Functional Constituents in Sweetpotato Tops and How They Differ During Their Growth Period

Terumi Sugawara and Jiong-Yan Gu

Laboratory of Farm Operation Mechanization Systems

Sweetpotato tops contain various elements useful to human body, including vitamins, minerals, and proteins and are rich in polyphenols, recently recognized for their physiological functions. Polyphenols may protect the human body from oxidative stress, which may cause cancer, aging and cardiovascular disease. The chlorophyll in the tops has physiological activities, known to be effective for blood formation, promotion of liver function and so on. Sweetpotato tops have been studied in our research center (KONARC) and found to be an excellent function food material. We aim to develop food materials containing large amounts of functional elements, such as polyphenols and chlorophyll.

Sweetpotato tops can be harvested several times a year over many months. To obtain a higher content of raw materials, we need to know how and when to harvest the tops. The relationship between the content of the tops and the harvest time was revealed in a previous study. The present study investigates the influence of the growth period of tops on the polyphenols and chlorophyll content.

MATERIALS AND METHODS

Sweetpotato Top Materials

The Shiroyutaka sweetpotato variety was used. The storage roots were planted on March 11 in a greenhouse at our research center (KONARC). The tops were cut at the ground surface once on June 26. They were cut again after the second, third and fourth weeks. The newly grown tops were harvested and used as samples.

Preparation

100g of tops were washed in water then wrapped in the food-use film and heated in a microwave oven (600W) for 100 seconds. The tops were processed to a paste in a food processor then enclosed in plastic bags and immediately frozen at –32℃. The samples were freeze-dried, powdered and used for laboratory analysis.

Measurement Particular

1) Moisture Content (Calculated by the decrease in weight)
2) Total Polyphenols (Determined by the Folin-Chiocalteu method)
3) Chlorophyll contents (Measured absorbance at 663nm of 80% ethanol extraction)

RESULT AND DISCUSSION

1) The moisture content of the tops grown for tow weeks was higher than those grown for three and four weeks (Fig. 1). A lower moisture content of the raw materials is better for drying.
2) The total polyphenols content differed during their growth period (Fig. 2). The total polyphenol content of the samples of the third and fourth weeks increased compared to samples grown for two weeks. This suggests the production of polypenols in the tops was promoted from the second week to the third week.
3) The chlorophyll content in the tops differed depending on the growth period (Fig. 3). Although the difference in the contents of chlorophyll between the second and third week growth periods was barely visible, polyphenol content was increased after four weeks.

These results revealed we could obtain the proper raw materials containing high amounts of polyphenols and chlorophylls by harvesting the tops from the third and fourth week growth periods. This was also advantageous for better drying.

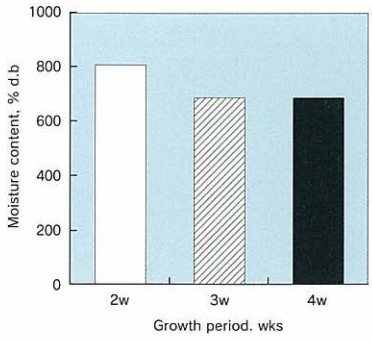


Fig.1. Relationship between moisture content and growth period

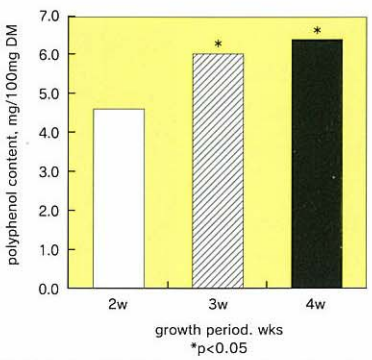


Fig.2. Relationship between polyphenol content and growth period

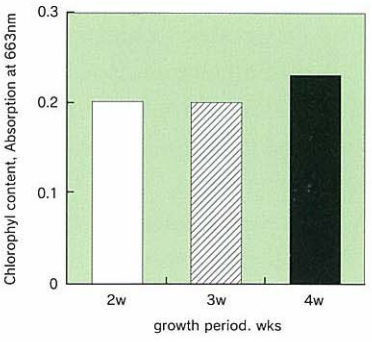


Fig.3. Relationship between chlorophyll content and growth period

Benimasari: New Sweetpotato Cultivar for Table Use

Koji Ishiguro, Osamu Yamakawa, Toru Kumagai

Yumi Kai and Yoshinori Nakazawa

Laboratory of Sweetpotato Breeding

Introduction

"Benimasari" is a newly released cultivar with a yellow flesh, developed by the National Agricultural Research Center for Kyushu Okinawa Region (formerly Kyushu National Agricultural Experiment Station). It was evaluated in the prefectural agricultural experiment stations as breeding line "Kyushu No. 130," and officially registered in 2001 for table use as "Sweetpotato Norin No. 55" by the Ministry of Agriculture, Forestry and Fisheries.

Origin

Benimasari is a progeny from a cross between Kyushu No. 104 and Kyukei 87010-21 performed at the Ibusuki branch of the station in 1992. Kyushu No. 104 is a breeding line with a red skin and good taste. Kyukei 87010-21 is a breeding line that has good taste and appearance. Collected 327 seeds were sown in the nursery of the Sweetpotato Breeding Laboratory and selected based on the field performance, taste and appearance.

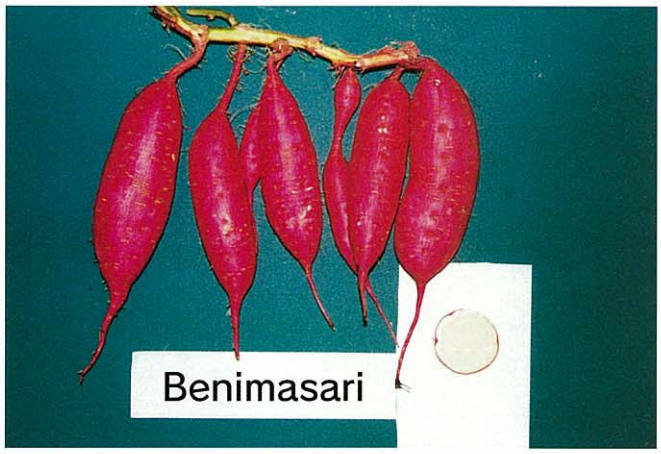
Description

Benimasari has a slightly better sprouting ability and is an intermediate plant type. The top leaves are light green. The mature leaves are green and heart-shaped. The vines are somewhat thick with slightly shorter internode lengths. Vines and vine nodes pigmentation of anthocyanin are absent. Storage roots are uniformly shaped, with red skin and yellow flesh. The taste of the steamed root was evaluated as excellent in the sensory test. The texture of the steamed root is a little sticky and clear yellow in color. This is a new type variety for table use, because the breeding program for table use has been to release cultivars with dry flesh.

Performance

The yield of Benimasari is considerably higher than that of Kokei No. 14 but lower than that of Koganesengan. Dry matter content is slightly higher than that of Kokei No. 14 but less than that of Koganesengan. The Brix percent is slightly higher than those of Kokei No. 14 and Koganesengan.

Benimasari exhibits intermediate resistance to root knot nematode, root lesion nematode, and black rot. The roots store well throughout winter.



Yield and other traits of Benimasari in yield trial (1997-2000, standard cultivation)

Trait	Benimasari	Kokei No. 14	Koganesengan
Root yield (t/ha)	24.7	21.4	26.1
Root size (g)	216	217	216
Number. of roots per hill	3.3	2.7	3.3
Dry matter content (%)	34.3	33.2	36.5
Brix (%)	4.9	4.5	4.6
Root-knot nematode resistance[1)]	I	SS	SS
Root-lesion nematode resistance[1)]	I	I	SS
Black rot resistance[1)]	R	S	S
Storage ability[2)]	SH	M	SL

1) R: Resistant. SR: Slightly Resistant. I: Intermediate. SS: Slightly Susceptible. S: Susceptible.

2) SH: Slightly High. M: Medium. SL: Slightly Low.

Research Paper

Physiological Functions of 'Suioh' Leaves

Koji Ishiguro, Osamu Yamakawa, and Makoto Yoshimoto

Laboratory of Upland Crop Utilization

In Japan, sweetpotato tops have limited use compared to the tubers. They have much more potential because the protein, vitamins and minerals are comparable to other commercial vegetables. There are also much higher levels of polyphenols in sweetpotato tops than in other commercial vegetables, and polyphenols have many physiological functions, such as anti-oxidant activity and cancer-fighting properties. We have now developed a new sweetpotato cultivar, called "Suioh" for utilization as an edible green vegetable. In this paper, we examined the polyphenol content of Suioh and its physiological functions as a radical-scavenging nutrient and its antimutagenicity.

The total polyphenol content of Suioh leaves was compared to that of other leafy vegetables. The total polypenol content of Suioh was found to be 4.95g/100g DW, the same as that of garland chrysanthemum and higher than the content of spinach, broccoli, cabbage and lettuce(Fig.1). Our recent study revealed that the polypenol content ranged from 1.42 to 17.1 mg/100g DW with a mean of 5.56, from among 1,389 genotypes. Among sweetpotato genotypes, the polyphenol content of Suioh leaves is in the middle range. The content can be considered moderate and acceptable for eating. Higher levels of polyphenol have been known to introduce harshness.

Since polyphenols are antioxidants, Suioh was expected to exhibit strong radical-scavenging activity. As expected, Suioh leaves had the highest activity level among tested vegetables (Fig. 1). A positive correlation between polyphenol content and radical scavenging activity was observed ($r=0.955$, $p<0.01$).

Antimutagenicity was also evaluated in Suioh leaves and leafy vegetables. Suioh leaves exhibited the highest activity, that is, its inhibitory effect of mutagenicity of Trp-P-1 to *Salmonella typhimurium* TA 98 was strongest among tested vegetables (Fig. 2). Notably, the consumption of Suioh leaves as a vegetable or as processed food could help eliminate radicals generated in the body, protects us against mutagens, and can thus be helpful in preventing diseases.

Suioh means "noble green color" in Japanese. This new cultivar has a high yield and can be harvested repeatedly, at times when few other leafy vegetables can usually be grown. Suioh leaves are also a rich in iron, calcium and carotene. Their use can help reduce vitamin A and iron deficiencies, which are severe problems among people in developing countries. Recently, leafy vegetable juices made from kales or young leaves of barley have become popular, which is attributed to a higher level of health consciousness in Japan. Therefore, Suioh tops can be expected to become an ingredient in drinks, processed foods and nutritional supplements. These are already currently in development. Their use in medicines is also expected.

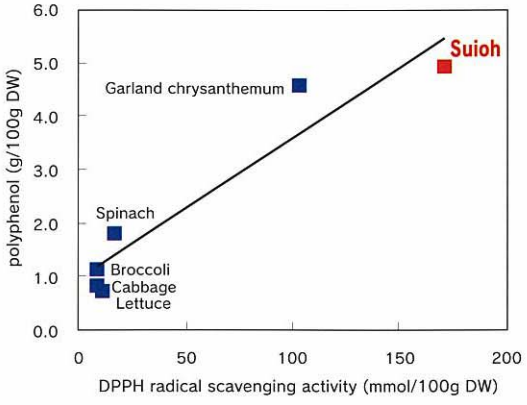


Fig. 1. Correlation between polyphenol content and DPPH radical scavenging activity among leafy vegetables.

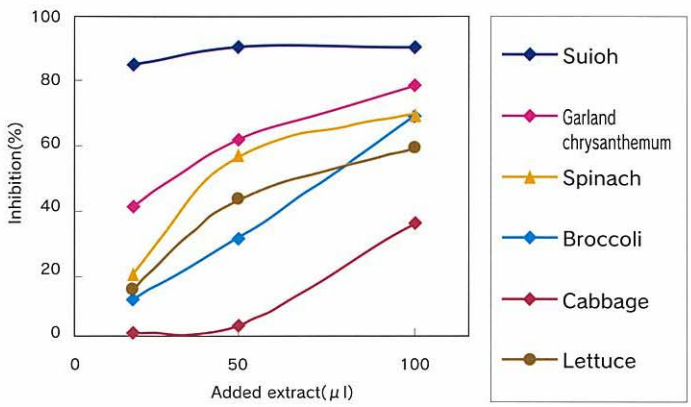


Fig. 2. Antimutagenicity of Suioh leaves and leafy vegetables.

Research News

Introduction of the Research Fellows of the Cooperative System for Supporting Priority Research on Sweetpotato

Research Fellows in Dept. of Crop and Food Science in Nishigoshi

Tomoyuki Oki, Mami Masuda and Mio Kobayashi

We, Mr. Tomoyuki Oki, Miss Mami Masuda and Miss Mio Kobayashi, are the research fellows of the cooperative system for supporting priority research conducted by the Japan Science and Technology (JST) corporation. Our host researchers are Dr. Tetsuo Sato, Associate Director for Research in the Dept. of Crop and Food Science, and Dr. Ikuo Suda, Chief of Food Functions Lab. Mr. Oki has a Ph.D. in agriculture. His specific fields are food analysis and food functions. Miss Masuda is a Medical Laboratory Technologist licensed by the Ministry of Health, Labor and Welfare. Miss Kabayashi, who has a Master's degree in Agriculture, has a technique for evaluating physiological functions in vivo. We have conducted research together with Dr. Sato, Dr. Suda and other researchers in the Assessment Center of the Food Functionality & Analysis Center for Crop Breeding in the Lab. of Food Functions. Our research seeks to prevent life-style disease by ingestion of special farm products harvested in the Kyushu and Okinawa regions and their processed foods. Among these farm products, the purple-fleshed sweetpotato is well known as a crop with physiological function, and to us is one of the most interesting farm products. To date, we have reported the following findings concerning the purple-fleshed sweetpotato.

1) Involvement of anthocyanins and other phenolic compounds in radical-scavenging activity of the purple-fleshed sweetpotato cultivars

2) Simple and rapid spectrophotometric method for selecting purple-fleshed sweetpotato cultivars with high radical-scavenging activity

3) Direct absorption of acylated anthocyanin in purple-fleshed sweetpotato into rats

4)Elevation of plasma antioxidant capacity after administration of purple-fleshed sweetpotato concentrate into rats

Research Fellows in Dept. of Upland Crop Research in Miyakonojo

Rie Kurata in Lab. of Upland Crop Utilization

In this laboratory, we are studying the physiological function of upland crops and characteristics of those crop components to develop new ways to utilize them. Of course, the major target crop is the sweetpotato.

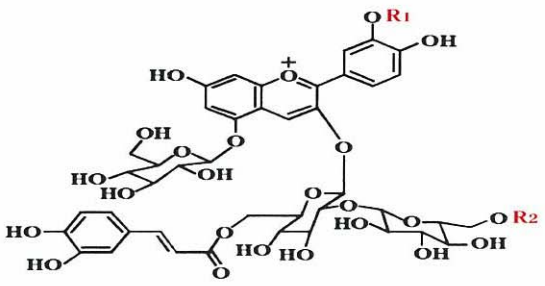
I have searched for new functions of sweetpotato roots and tops using various kinds of cultured cells. Other new effects of purified polyphenolic components on various kinds of enzymes concerned with life-style disease have also been investigated.

The nutritional value of the sweetpotato is excellent, and the sweetpotato is rich in physiological functions. I want to advance the search for new functionality.

Jun Toyama in Lab. of Sweetpotato Breeding

My special field is plant breeding. I routinely analyze secondary metabolites, amino acids and enzymes both for *in vitro* and *in vivo* systems.

One of the main goals of our research is to develop sweetpotato varieties with useful components, for both human and animal consumption. The target compounds are polyphenols, anthocyanins, trypsin inhibitors, and other proteins. My present objectives are as follows. 1) To develop techniques for rapid analysis of these components. 2) To study the variety of differences in such useful components. 3) To identify specific proteins responsible for trypsin inhibiting activity. The results will help us select superior sweetpotato varieties.



Cyanidin type (R_1=H)	Peonidin type (R_1=CH_3)	R_2
YGM-1b	YGM-4b	caffeic acid
YGM-1a	YGM-5a	*p*-hydroxy benzoic acid
YGM-2	YGM-5b	H
YGM-3	YGM-6	ferulic acid

Fig. 1. Chemical structure of major anthocyanins in purple-fleshed sweetpotato.

Announcements

Erratum

SUDA, I. et al.(2002); Direct absorption of acylated anthocyanin contained in purple-fleshed "Ayamurasaki" sweetpotato cultivars by rats. SPORF, 14, p.4

Figure 1 is being replaced. The new Fig. 1 appears below.

Reader's Talk

Letter to the editor

Short Training in the National Agricultural Research Center for Kyushu Okinawa Region (KONARC)

Cecilia Ynouye

International Potato Center

I came from CIP-Lima (Peru) to complete a three-month training course in functional food science, sponsored by the Japan International Cooperation Agency (JICA).

Peru is recognized as one of the important global centers of genetic diversity in the world. Many Andean crops are thought to have functional components with physiological functions that may maintain and improve health based on their traditional uses, but these functional components have scarcely been studied. The limited information available on many important and basic aspects of neglected and underutilized crops hinders their development and sustainable conservation. Despite decades of research and development initiatives, more than 60% of the rural inhabitants of the Andes still live in poverty. It is important to find new ways to increase the farmer's income in the Highlands through the sustainable use and export of their crops and the development of products manufactured from them, along with protecting and maintaining the genetic heritage of Andean farmers.

During the training period, I worked with molasses, a by-product of the manufacturing of sugar cane, to determine the physiological functional components. In KONARC, I was given use of all the facilities to fulfill the objectives of my training.

I am convinced that understanding or knowing the physiological functions of a crop or food is an important factor for developing new uses and for promoting the crop. The development of functional foods is a unique opportunity to contribute to the improvement of the quality of food and consumer health and well-being. In addition, research data on functional food science not only should be published in scientific journals, but accessible for everyone in order to promote the consumption of a food or crop. It is also very important to teach people how to consume it and to find new end-uses.

I came to Japan to learn these techniques, and I certainly learned more than that. My memories of Japan go far deeper than the experience gained at work.

Although three months is a very short time to get to know Japan and to understand its society, I have tried to learn well about Japan and its people. I didn't want to miss the opportunity to go to many beautiful and interesting places during my free days and to appreciate the beauty of Japan. I was so impressed because they were able to preserve and treasure their traditional culture and also to conserve many green areas in spite of being an industrial country. Through my trips, I have come to understand what Japan actually is.

I also have a good impression of the Japanese lifestyle, culture and traditions. The Japanese people are full of kindness, hospitality, good manners and gentility. I admired the waste management disposal system. I think the public transportation system, is almost perfect.

I will always cherish the time I have spent here in this beautiful place, with wonderful people. I will hold a special place in my heart for the friendships that I have developed, and I believe will exist beyond the international barriers.

Now it is time to return to my country with many sweet memories. I find myself enriched and equipped with knowledge and skills that definitely will help me in serving my country. I would like to thank JICA, Dr. Yamakawa, Dr. Yoshimoto, all of the staff of KONARC, Jun chan, Koji chan and those who supported me during my stay and for this wonderful experience in Japan.

Editor's note

I have participated in the editing of SPORF from the first issue. I am increasingly impressed with the potential of sweetpotato . (M.Y.)

Sweetpotato Research Front (SPORF)
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