



# Sweetpotato Research Front

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## Contents

Cover Story:	Thinking about sweetpotato research and expectations for SPORF	1
Research Paper:	Newfound Sweetpotato Spirits "AKA-KIRISHIMA" Made from Purple-fleshed Variety "Murasakimasari"	2
	Effect of Koji Extract on Polyphenolic Components	3
	Ayakomachi: New Sweetpotato Cultivar for Cooking Material and Table Use	4
Research News:	Report of 13 <sup>th</sup> Symposium of the International Society for Tropical Root Crops Held in Tanzania	5
	Report of 17th Annual Meeting on Root-Crop Research	6

## Thinking about sweetpotato research and expectations for SPORF

*Nobuyuki Sawamura*

Director, Department of Upland Farming Research, KONARC



Last October I was inaugurated as director of the Department of Upland Farming Research, KONARC. I have been engaged in agricultural mechanization research mainly for rice since 1971. Today rice cultivation is fully mechanized from transplanting to harvesting and drying. However, sweetpotato mechanization has not been completed. In Japan, planting acreage of the sweetpotato has been decreasing for many years in spite of the efforts to breed new varieties, cultural improvements, and various governmental subsidies. I think the sweetpotato is one of the most significant upland crops from the viewpoint of sustainable land use. Sweetpotatoes have been used mainly as materials of starch and liquor, as well as table use. Recently many new unique varieties have been released through KONARC, such as high anthocyanin content AYAMURASAKI and high

carotene content SUNNY RED. KONARC's researchers also revealed that sweetpotatoes have special physiological effects such as fighting cancer and diabetes. They are used not only for table-use as a health food but also for processing i.e. natural food colors, health drinks, and seasonings. Consumers are interested in these colored sweetpotatoes and their processed foods. Some colored sweetpotatoes are even good for nematode population control. KONARC also has a research project for farming system improvements, based on mechanized crop rotation with sweetpotatoes and other vegetables. I believe that our research activities should encourage the farmers in southwestern Japan to increase sweetpotato production. SPORF is a newsletter of our sweetpotato research activities. SPORF has been distributed among agricultural research organizations globally. I hope that sweetpotato research worldwide is strengthened through SPORF.

# Research Paper

## Newfound Sweetpotato Spirits “AKA-KIRISHIMA” Made from Purple-fleshed Variety “Murasakimasari”

*Masaru Yoshinaga*

Laboratory of Sweetpotato Breeding

Sweetpotato spirits (Imo shochu) are booming in Japan, especially in Tokyo. A short time ago people preferred palatable, less aromatic barley or buckwheat spirits to the sweetpotato. However, now men and women of all ages enjoy drinking sweetpotato spirits in a variety of ways, such as on the rocks, and blended with hot water or fruit juice. The shochu brewery industry believes that the boom will continue for at least three to four years.

The distinctive aroma of sweetpotato spirits is characterized by several mono-terpene alcohol components. The raw storage roots have little smell, like shochu, because mono-terpene alcohol exists as a glycoside. During alcohol fermentation,  $\beta$ -glycosidase activity (produced by shochu koji (*Aspergillus kawachii*)) changes the glycoside to non-glycoside, producing the distinctive aroma. Interestingly, the aroma of sweetpotato spirits was recently found to differ among sweetpotato varieties. For example, the spirit made from the white-fleshed “Joy White,” released in 1994, exhibits a fruitier aroma compared with that of “Koganesengan,” a leading variety for shochu. Our laboratory has continued to select breeding lines suitable for distinctive sweetpotato spirits in collaboration with shochu brewery industry.

The most recent achievement is the birth of a new

product, “AKA-KIRISHIMA,” by Kirishima Co., Ltd. in 2003. “AKA-KIRISHIMA” has a slightly sweet and wine-like aroma. “AKA-KIRISHIMA” is a purple-fleshed variety of “Murasakimasari,” released in 2001 for food colorant production and processing use. “Murasakimasari” exhibits a high dry-matter content similar to “Koganesengan,” and the anthocyanin content is equal to the “Ayamurasaki,” released in 1995. The yield is also high, so it is a suitable material of sweetpotato spirits. “AKA-KIRISHIMA” is a red brand in the line-up of shochu products of Kirishima Co. Ltd. Distilled “AKA-KIRISHIMA” has no color. However, Moromi (fermenting actively in a tank), a mixture of steamed and mashed sweetpotato, shochu koji, and alcoholic fermentation yeast, possesses a brilliant red color due to anthocyanins under citric acid, accumulated in Moromi as a by-product of shochu koji.



A bottle of “AKA-KIRISHIMA”(proof 25, 900mL, 1,120 yen)



Storage roots of “Murasakimasari”



Brilliant red Moromi containing 15% alcohol after fermentation for eight days

## Effect of Koji Extract on Polyphenolic Components

*Makoto Yoshimoto and Rie Kurata*

Laboratory of Upland Crop Utilization

Sweetpotato shochu is very popular liquor in Japan. Recent increases of shochu production have resulted in the enormous output of distillery by-products. We focused on phenolic compounds in the shochu distillery by-product (SDB), since sweetpotato storage roots contain a high content of polyphenolic compounds, and they are relatively heat-stable. Polyphenolic components are known to possess antioxidant activities and to act as selective food antioxidants as well. However, the medical values of phenolics vary by each component.

We describe in this paper the effect of the koji extract on various kinds of polyphenolic components.

During shochu production, the “Koganesengan” root is steamed, and the starch is saccharified by the koji followed by alcohol fermentation. Therefore, raw and steamed root were lyophilized and powdered. Polyphenolic component was extracted by 80% ethanol solution and used as the sample. SDB from “Koganesengan” root (Den-en Shuzo, Inc.) was then added. The koji (*Aspergillus awamori* mut., 4 g) was vigorously mixed with 20 ml of 0.1 M sodium acetate buffer (pH 5.0) containing 86 mM sodium chloride at 25°C for 3 hr. The supernatant was filtered through a cellulose acetate membrane (0.45 µm, Advantec, Tokyo, Japan), and the filtrate was used as the crude extract. The polyphenolic and koji extracts were mixed at a 6: 4 ratio and incubated at 50°C for 16 hr. The samples were filtered through a cellulose acetate membrane (0.20 µm, Advantec, Tokyo, Japan), and the filtrate was used as a

sample for HPLC analysis with a YMC-Pack ODS-AM column (4.6 mm ID x150 mm, 5µm particles; YMC, Kyoto, Japan). Each polyphenol was compared with an authentic sample.

HPLC patterns of polyphenolic composition, between the raw and steamed root, and the SDB, were compared to clarify the origin of caffeic acid (CA) and other compounds in the sweetpotato SDB (Table 1). Peaks in the raw storage root were identified as chlorogenic acid (ChA) and 3,5-di-*O*-caffeoylquinic acid (3,5-diCQA). We detected six peaks in the steamed storage root, including ChA, 4,5-di-*O*-caffeoylquinic acid (4,5-diCQA), 3,5-diCQA and 3,4-di-*O*-caffeoylquinic acid (3,4-diCQA). The peak corresponding to CA was seldom observed in the raw and steamed storage root. This data indicated the degradation of phenolic components by steaming. CA and other phenolic compounds existed in the SDB. The results of the reaction of SDB and purified polyphenolics, with koji extract, are summarized in Table 1. ChA and di-CQAs were hydrolyzed to CA, suggesting that CA production in SDB is caused by the work of the koji.

In conclusion, we found that treating sweetpotato SDB with the koji might convert the caffeoylquinic acid derivatives to CA. Several reports demonstrated that CA is absorbed after oral administration and results in increased antioxidant capacity in vivo. This means that the koji treatment of agricultural by-products, such as sweetpotato leaves with the caffeoylquinic acid derivatives may be applicable for CA production.

**Table 1** Effect of koji extract on polyphenolic components

Samples	Polyphenolic components				
	CA	ChA	3,5-diCQA	3,4-diCQA	4,5-diCQA
Raw root	-	+	+	-	-
Steamed root	-	+	+	+	+
Koji-untreated SDB	+	-	-	-	-
Koji-treated SDB	+	-	-	-	-
ChA	+	-	-	-	-
3,5-diCQA	+	-	-	-	-
3,4-diCQA	+	-	-	-	-
4,5-diCQA	+	-	-	-	-

+,detected; -,non-detected.

# Research Paper

## Ayakomachi: New Sweetpotato Cultivar for Cooking Material and Table Use

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### Laboratory of Sweetpotato Breeding

#### Introduction

“Ayakomachi” is a newly released cultivar with orange flesh and good appearance, developed by the National Agricultural Research Center for Kyushu Okinawa Region. It was evaluated in prefectural agricultural experiment stations as breeding line “Kyushu No. 134”, and officially registered as “Sweetpotato Norin No. 60” by the Ministry of Agriculture, Forestry and Fisheries in 2003 for cooking material and table use.



#### Origin

“Ayakomachi” is a progeny from a cross between “Sunny Red” and “Hamakomachi” performed at the Ibusuki branch of the station in 1993. A total of 266 seeds were sown in the nursery of Sweetpotato Breeding Laboratory, and selected based on field performance, taste, and appearance. “Sunny Red” is a cultivar for food processing and has high carotenoid and relatively high starch content. “Hamakomachi” is a new cultivar for food processing and has high yield and carotenoid content.

#### Description

“Ayakomachi”, a slightly prostrate plant type, has a moderate sprouting ability. The top leaves are light green. The mature leaves are green and toothed heart-shaped. The vines possess a medium thickness with a slightly short internodes length. Vines and vine nodes pigmentation of anthocyanin are pale. Storage roots are uniformly fusiform, with a good shape, red skin color, and orange flesh color. The steamed root texture is a little sticky and has average taste, as good as “Sunny Red”. “Ayakomachi” is suitable for cooking or preparing salads.



Salad made from boiled root of “Ayakomachi”

#### Performance

Ayakomachi's yielding ability is comparable to that of “Sunny Red”, and slightly less than that of “Kokei No. 14”. Dry matter content is less than that of “Sunny Red” and “Kokei No.14”. Beta-carotene content is 30mg per 100g dry weight.

Yield and other traits of “Ayakomachi” in yield trial (1998-2002, standard harvesting)

Traits	Ayakomachi	Sunuy Red	Kokei No.14
Root yield (t/ha)	25.2	25.4	26.3
Root size (g)	170	213	235
No.of roots per hill	4.0	3.3	2.9
Dry matter content (%)	29.6	32.7	33.7
Brix (%)	5.0	4.1	5.1
Beta-carotene(mg) <sup>1)</sup>	30.0	36.0	—
Storability <sup>2)</sup>	H	SH	SH

1) Data in 1999 - 2000. Per 100g DW

2) H:High, SH:Slightly High

# Research News

## Report of 13<sup>th</sup> Symposium of the International Society for Tropical Root Crops Held in Tanzania

*Koji Ishiguro*

Laboratory of Upland Crop Utilization

The 13<sup>th</sup> symposium of the International Society for Tropical Root Crops (ISTRC) was held November 10-14, 2003, in Arusha, Tanzania. Over 200 researchers from all over the world, especially African countries, participated in the symposium and reported their activities in the sessions of vitamin A for Africa, socio-economics, agronomy, plant protection, post harvest, breeding, and technology transfer. Dr. Makoto Yoshimoto, Mr. Jun Toyama, and Dr. Koji Ishiguro from KONARC; Dr. Makoto Nakatani from NARC; Dr. Toshihiko Sukanuma from Kagoshima University; and Dr. Takiko Shimada from Ishikawa Agricultural College were the Japanese delegates. We made presentations on the theme "Potential Chemopreventive Properties of Caffeoylquinic Acid Derivatives from Sweetpotato (*Ipomoea batatas* L.) Leaves," "Selection of Sweetpotato with High Protein and/or Low Trypsin Inhibitor Activity," "Nutrition and Utilization of a New Sweetpotato Cultivar for Tops," "New Sweetpotato Cultivar, 'Quick Sweet' having Low Gelatinization Temperature and Altered Starch Structure," "Chemical Structure and Physicochemical Properties of Low-tempera-

ture-gelatinizing Starch from New Sweetpotatoes," and "Production of Amylose-free Sweetpotato Plants by RNAi." Dr. Shimada received the Best Poster Award and I received the Best Paper Award with great pleasure and surprise. This award encouraged me to conduct future sweetpotato studies.

I understood the urgency of poverty alleviation and sustainable livelihoods in the developing world with tropical root crops and of combating vitamin A deficiency, which is promoted by VITAA (Vitamin A for Africa), through the symposium. I hope that our sweetpotato research will contribute to these crucial topics.

We visited Arusha National Park and NgroNgro creator. I was impressed with the wild animals and will never forget the magnificent scenery.

I had a comfortable stay thanks to the cool weather in Arusha, the participants, and the staff. I thank all of them for their support and kindness.

*ASANTE*, Tanzania and Africa!



# Research News

## Report of 17th Annual Meeting on Root-Crop Research

*Masaru Yoshinaga*

### Laboratory of Sweetpotato Breeding

The 17th annual meeting on Root-Crop Research was held on December 4-5, 2003, in Kagoshima Prefecture. The 75 attending researchers exchanged research information about the sweetpotato and Irish potato. Here is the outline of sweetpotato research discussed in the meeting.

The sweetpotato-breeding laboratory of KONARC reported the breeding line performance in yield trials and regional adaptation tests. After the discussion, Kyushu-149, Kyushu-150, and Kyushu-151 were officially recognized as new lines for the next regional adaptation test. These promising lines possess yellow flesh and taste good. Kyushu-147, a non-sweet type with low dry-matter content, was announced as a new variety for cooking, such as croquette and chips, in 2004.



The following short research topics were presented: (1) Development of a small electric-powered truck for efficient transplanting by hand, (2) Quality improvement for the traditional Japanese dried sweetpotato food "Hoshiimo," (3) Sugar accumulation during storage of purple-fleshed variety Tanegashimamurasaki, (4) Components with physiological functions to remedy eye troubles included in sweetpotato leaves, (5) Report on International Symposium on Tropical Root Crops 2003, held in Tanzania.

The final session of the meeting consisted of special lectures on the sweetpotato nematode. Dr. Sano, KONARC, gave a presentation on regional race-distribution of the southern root-knot nematode, and on the race-dependent nematode resistance of sweetpotato varieties. Dr. Kawasaki, Kagoshima Pref., introduced research on reducing nematode density by cropping the Guinea grass after the sweetpotato. There were also discussions about the importance of a cropping system and sweetpotato breeding according to nematode races. An opinion was expressed that researchers should promote a demonstration of the cropping system, which combines nematode race-dependent resistance cultivars with nematode-enemy plants, and should evaluate the cost-effectiveness of environment-friendly technology.

#### Announcements

Dr. Nakazawa previous SPORF editor, moved to Soybean Breeding Lab., KONARC. In his place, we welcome Dr. Yoshinaga as a new editor. Hereafter, please contact Masaru Yoshinaga to inquire about SPORF.

#### Editor's note

The sweetpotatoe is a very useful crop. I felt the wonderfulness of the sweetpotato anew. (H.I.)



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