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COMPARISON OF TUBER PROTEINS OF YAM INTRODUCED FROM THE POHNPEI ISLAND AND YAP PROPER, THE FEDERATED STATES OF MICRONESIA

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Abstract

Yam belongs to the genus of *Dioscorea*, in the Pacific Islands, mainly four species of *Dioscorea* are cultivated. We collected some tubers of yam from the Pacific Islands, especially Pohnpei Island and Yap Proper. Most yam tubers have viscosity that is composed of proteins. We examined the differences of tuber proteins of yam by using polyacrylamide gel electrophoresis method.

Keywords: *Dioscorea* spp., polyacrylamide gel electrophoresis, Pohnpei Island, tuber protein, Yap Proper

Introduction

Yam is the generic name of plants belonging to the genus of *Dioscorea, Dioscoreaseae*. In the Pacific Islands, yams (*Dioscorea alata, D. esculenta*, and *D. nummularia*) and aerial yam (*D. bulbifera*) are cultivated (Society of the Pacific 1989). In the Pohnpei Islands and in Yap Proper, the Federated States of Micronesia, *D. alata* and *D. esculenta* are the primary species cultivated and used for food. Because the *alata* species is used for various ceremonies in the Pohnpei Islands, inhabitants sometimes compete to grow the largest tubers. Therefore, while the normal tuber weight per plant of the *alata* species reaches a maximum of more than 500 kilograms, sometimes weights 20 times as large can be seen (STANLEY 1992).

During our 1994 survey of the Pohnpei Islands, we were able to identify 20 or more different strains of the *alata* species, so we estimated that many different strains exist on this island.

However, there are few examples of positive cultivation of the *nummularia* or *bulbifera* species because they include some poisonous strains and at present are positioned as emergency crops.

The authors have been participating in the Overseas Academic Survey by the Kagoshima University Research Center for the Pacific Islands since 1994. During this period, we collected five species of yam from both islands and, by storing them in the Kagoshima University Experimental Farm Ibusuki Botanical Garden, have continued cultivating them.

These species of yam have been studied mainly from the aspects of yield and earliness, but relatively few studies have been conducted from the aspect of nutrition. Generally speaking, many yam tubers are viscous, and the main component producing viscosity is protein. Though protein is an important nutritive element, there are few studies of yam protein and many points have not yet been clarified. In this study, therefore, we investigated the differences in tuber pro-

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tein as the first phase for attempting an analysis of the species of yam collected on both islands from the aspect of nutrition.

Materials and Methods

In this study, we tested the 11 strains of the three species of yam we collected in the Pohnpei Islands, Federated States of Micronesia, where we implemented several on-site surveys from 1994 to 2001 (see Table 1). Because the strains were not clearly named, we assigned a number to each strain. Of the tubers we collected on Yap Proper in November 2000, we directly analyzed only Yp4, tubers harvested from the plants cultivated continuously in the Ibusuki Botanical Garden after the collection was used for analyzing other strains.

Table 1. Characteristics of tubers in tested strains of *Dioscorea* spp.

Strain's No.*	Species	Characteristics of tubers			
		Shape	Color	Change of color	Viscosity
P 1	*alata*	Round	White	Non	Middle
P 2	*alata*	Cylinder	Light purple	Non	Soft
P 9	Unknow	Round	White	Non	Middle
P 14	Unknow	Cylinder	White	Non	Middle
P 17	*alata*	Cylinder	Light purple	Non	soft
P 20	*bulbifera*	Round	Light purple	Brown	Very soft
Yp 1	*bulbifera*	Glove	Light purple	Brown	Very soft
Yp 2	*alata*	Glove	White	Brown	Middle
Yp 3	*esculenta*	Round	Cream	Brown	Strong
Yp 4	*esculenta*	Round	Cream	Brown	Strong
Yp 5	*alata*	Round	White	Non	Middle
Solo yam	*alata*	Round	White	Non	Strong

*: P: Pohnpei island in F.S.M., Yp: Yap Proper in F.S.M.,
Solo yam: Indonesia

The "Solo yam" strain was introduced from Indonesia by Kagoshima University (ISHIHATA et al. 1984). It is currently cultivated on Yaku Island and has been used by the authors as the indicator plant in the studies of yam, so the Solo yam strain was also used in this study for comparison. First, we investigated the form and color of the tubers harvested in December 2001. We then placed a tuber into a mortar cooled to -20 °C, poured acetone cooled in the same manner into the mortar, and crushed the tuber immediately. We extracted and filtered the juice and then fully dried it to produce acetone powder. Using this acetone powder, we investigated differences in protein by the NON-SDS polyacrylamide gel electrophoresis method.

After grating the tuber with a household plastic grater, we compared viscosities by visual inspection using the viscosity of Solo yam as the reference (strong).

Results and Discussion

Table 1 shows the characteristics of the strains subjected to this study. Six strains of the *alata* species, two of the *esculenta* species, two of the *bulbifera* species, and two unknown species were tested. The unknown species resemble the *alata* species in form, but the cross section

of the stem of the *alata* species is rectangular and that of the unknown species is round. Furthermore, wings of stem are not observed in the unknown species, and its form differs in many points from the *esculenta* species and others reported to be cultivated in the Pacific islands. Therefore, though we plan to analyze that species on the DNA level, we treated it as an unknown in this study. From the morphological observation of the leaves and stems, we conjecture that these two strains belong to the same species.

First, we investigated the form and color of the tuber, presence or absence of discoloration, and viscosity. The forms of tubers varied from round to cylindrical in the same species. Color varied from white and cream to light violet, and we found no correlation between the form and color. We observed discoloration after grating in all strains of the *esculenta* species and *bulbifera* species and one strain of the *alata* species.

The viscosity examination results revealed that the two strains of the *esculenta* species had a viscosity almost equal to that of Solo yam, which has the highest viscosity among the strains so far preserved. Furthermore, strains belonging to the same species of *alata* species had varying viscosities ranging from strong to weak. Though the *bulbifera* species is seldom used for food, many of its plants can be seen in mountains and fields, and it is sometimes used as emergency food during a famine. The viscosity of the *bulbifera* species was found to be very weak.

The results of NON-SDS polyacrylamide gel electrophoresis are shown in Fig. 1. We examined the detected bands and observed numerous bands with similar patterns among different strains belonging to the same species. In the *alata* species, therefore, even strains that have extremely different viscosities exhibit similar band patterns. We thus determined that viscous protein cannot always be detected by the NON-SDS polyacrylamide gel electrophoresis method used in this study. However, band patterns largely differ between species, so we considered that the types of protein existing in the tuber are somewhat similar within the same species. In the future, we are planning to conduct further studies of yam from the aspect of nutrition by implementing other types of electrophoresis methods and investigating the volumes of protein and starch components.

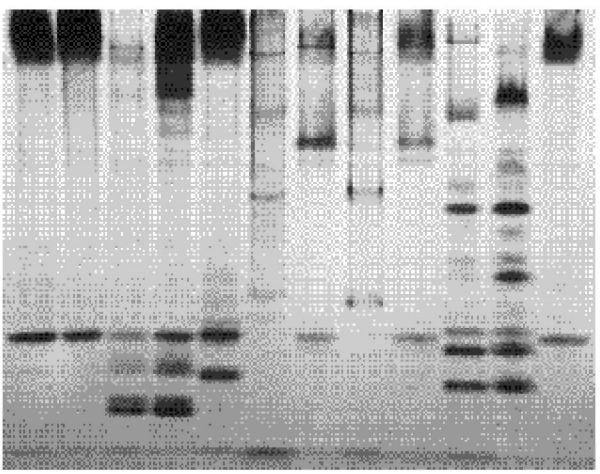

Fig. 1. Different band pattern of tuber protein of yam collected from Pohnpei island and Yap Proper by NON-SDS polyacrylamide gel electrophoresis

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