ISBN : 978-979-99046-1-4

PROCEEDING

INTERNATIONAL SEMINA

Upland for Food Securit

November 7 - 8, 2009
Purwokerto (Indonesia)

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Published by:
FACULTY OF AGRICULTURE
JENDERAL SOEDIRMAN UNIVERSITY
PURWOKERTO-INDONESIA

TEXTURAL PROPERTIES OF FLOUR OF SEVERAL COMMERCIAL *Dioscorea* SPECIES

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ABSTRACT

Dioscorea spp. tubers are dry land products, and staple food for some Asian and African people. In fact, Indonesia is the second largest home for *Dioscorea* species in the world. Some of the species gain considerable attention due to their health promoting effect. The aim of this research is to study the potential utilization of flour of some commercial *Dioscorea* species in Java and Madura; focusing on the study of textural characteristics. Tubers of *D. alata*, *D. esculenta* and *D. rotundata*whcih available in traditional market of Kamal and Kediri were used in the study. Flour of the tubers were examined for microscopical characteristic of starch granule, gelatinization profile, gel strength, gel rigidity, breaking point of gel, and gel hardness, as well as water absorption and water solubility index. Result showed that three species differed in microscopical appearance of starch granule, with very rough or spiky surface of *D. alata* starch, but smooth in other species. Gel of flour of all species showed retrogradation, and was relatively weak but *D. rotundata* was the strongest, most rigid, difficult to gelatinize and showed less retrogradation. Possible application of the flour in several food products was discussed.

Keywords: *Dioscorea*, flour, textural properties.

INTRODUCTION

Food crisis in Indonesia has led to exploration of alternatives, including new source of staple food. On the other hand, Indonesia is the second largest biodiversity in the world, thus owing abundant source of new plant for food security. One important aspect in food security is the availability of plant and nutritive values. It is an advantage to have functional properties of the new food source, such as hypoclolesterolemic, anti-obesity, anti-proliferatic, anti-oxidant and immune-enhancing activity.

Dioscorea tuber is staple food in some West African and Asian countries (FAOSTAT, 2001), and important source of carbohydrate. World production was around 21.8 million ton, with 90% of it came from West Africa especially Nigeria (Anonymous, 2008). In Africa, consumption per capita was around 65 kg, while annual production per plant was around 10-40 ton (Sefa-Dedeh, 2002). Among 235 species of *Dioscorea* spp. studied in 1997, Indonesia was the second country with second largest biodiversity of *Dioscorea* spp., with Papua New Guinea became country with the highest *Dioscorea* species. The most common commercial species are: *Dioscorearotundata*Poir (white yam), *D. cayanensis* Lam. (yellow yam), *D. alata* L. (ater yam) and *D. dumetorum* (bitter yam) (Anonymous, 2008). *D. alata* seems to be the most common species used in South Asian countries.

In Africa, traditionally, *Dioscorea* spp. is consumed as pasta-like food, or pudding. It may also prepared by first boiling then pounding to have certain textural characteristics, simply boiling, roasting, or frying the tuber. In pasta, pudding, boiled or fried products, their texture have very important properties (Akissoe*et al.* 2001). Their important characteristics are smoothness, stickiness, firmness and elasticity. These properties have strong connection with thermal and pasting behaviour of yam flour. Nevertheless, the preference varies with area and age.

In Indonesia, it is one of staple foods in the past, although today it is mostly consumed as snack. The tuber gains considerable attention today, due to its functional properties. In fact, it is an important component in traditional Chinese medicine to alleviate stomach problem and improve wellness in general. Among functional health-improving characteristics studied are hycholesterolemic effect, antioxidant and anti trypsin activity.

Some tubers of *Dioscorea* species contain oxalic acid and phytate, as a drawback for its consumption. Some tubers also show toxicity. Flour of *Dioscorea* flour has been studied previously and showed both advantages and drawbacks. Its gel is highly acid or heat resistant, which are the advantages in food processing. However, it easily undergoes retrogradation during storage.

Solubility and water holding capacity of *Dioscorea* flour gel was det rmined using method which applied previously (Hsu *et al.* (2003). For 2.5 g *Dioscorea* flour mixed with 30 mL aquadest, and heated in waterbath at 37°C for 30 minutes holding time. The mixture centrifuged at 4,000 g for 10 minutes. Supernatant then separated and weighted, while the precipitate was oven dried at 100°C for around 48 hours, and dried precipitate was weighted. Water solubility and absorption index were calculated using following formulas:

WAI = weight of supernatant: initial weight of flour

WSI = %residu: initial weight of flour

Proximate analysis was performed to determine amylose, ash and water content.

RESULT AND DISCUSSION

Microscopy examination

There were three types of *Dioscorea* available in Kamal market and Kediri, namely *Dioscoreaesculenta* (uwigembili), *Dioscoreabatatas*(uwiputih), and *Dioscoreaalata* (uwiungu/obbichelleng). Nevertheless, seemingly there are plenty of *Dioscorea*varities grow in Madura, as reflected by considerable number of names in different parts of Madura, such as obbi sola, obbita'al, obbiraddin, obbipote, obi atak, obi elos, dan obi gaddhung. Local people also consumed the aerial tuber (seed) of *Dioscorea* spp. ('kalenteng') which mostly have slight bitter taste. Some of the wild cultivar are very bitter, and not for consumption.

Microscopical observation showed a variety of granule shapes among the species studied. Most striking image was shown by starch granule of violet type *Dioscorea*alata, where it is highly irregular shape with several very sharp ends on the surface (sample from Kediri) or ridges on the surface (in sample from Kamal). The size of this granule was also relatively smaller (around ½ or 1/3) than others (Figure 1). In contrary, the shape of granule of *D. batatas* was relatively regular, slight oval with flat in one end, and smooth surface (Figure 2). Whilst, *D. esculenta* showed various shapes; from oval, oval with flat one end, or irregular shape and size, but smooth surface (Figure 3).

Shape and size of starch granule influence water absorption and rigidity of gel. Small starch granule facilitates larger surface area to better absorb water. Similarly, coarse surface of granule also facilitates better absorption of water.

(A) (B) (C)

Figure 1. Granule of *Dioscoreaalata* (violet type) from Kediri: (A) 100x; (B) 400x; (C) Granule of *Dioscoreaalata* (violet type) from Kamal (400x).

(A) (B)

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DISCUSSION

Willem Steven (Mahidol University):

Why do you use three varieties? And which one is the best?

U. Purwandari:

Species is so various that 3 species not only thing that researched. There are batatas

Siswantoro:

What kind of physical structure? And how about the strength?

U. Purwandari:

Physical structure is the strength of the gel. I did not find the right equipment from that (strength).