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PHYSICOCHEMICAL CHARACTERIZATION OF STARCH FROM VARIOUS VARIETIES OF SWEET POTATO (*Ipomoea batatas*)

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Physicochemical Characterization of Starch from Various Varieties of Sweet Potato *(Ipomoea batatas)*

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This project is submitted in partial fulfillment of the requirements for the degree of Bachelor of Science with Honors (Resource Chemistry)

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DECLARATION

No portion of the work referred in this dissertion has been submitted in support of an application for an other degree of qualification of this or any other university of institution of higher learning.

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TABLE OF CONTENTS

DECLARATION			ii
ACKNOWLEDGEMENT			iii
TABLE OF CONTENTS			iv
LIST OF TABLES			vi
LIST OF FIGURES			vii
LIST OF APPENDIX			viii
ABSTRAK			ix
ABSTRACT			ix
CHAPTER 1			10
INTRODUCTION			
	1.1	Introduction	10
	1.2	Objectives	12
CHAPTER 2			13
LITERATURE REVIEW			
	2.1	Source and Isolation	13
	2.2	Composition and Organization of Starch Granule	15
	2.3	Gelatinization	16
	2.4	Pasting Properties	17
	2.5	Retrogradation Properties	18
	2.6	Modified Starch	19
	2.7	Starch from *Ipomoea batatas*	20
CHAPTER 3			24
MATERIALS AND METHODS			
	3.1	Materials	24
	3.2	Starch isolation	24

3.3 Proximate Analysis
3.3.1 Moisture Content 25
3.3.2 Protein Contents 25
3.3.3 Lipid and Ash 26
3.4 Determination of Amylose 27
3.5 Swelling and Solubility 27
3.6 Freeze-thaw Stability and Syneresis 28

CHAPTER 4 29
RESULTS AND DISCUSSION
4.1 Characteristics of Sweet Potato 29
4.2 Proximate Composition of Sweet Potato Starches 32
4.3 Swelling and Solubility behavior of Sweet Potato Starches 35
4.4 Syneresis of Sweet Potato Starches 38

CHAPTER 5 42
CONCLUSION 42

REFERENCES 44

APPENDICES 54

LIST OF TABLES

Table 2.1	Characteristics of Some Starch Granules	15
Table 2.2	Chemical Compositions of Isolated Starches from Local Sweet Potato Varieties from Various Countries	
Table 2.3	Physical Properties of Isolated Starches from Local Sweet Potato Varieties from Various Countries	23
Table 4.1	Starch Content of Starches from 6 Varieties of Sweet Potatoes (w/w %)	30
Table 4.2	The Percentage of Starch Yield and The Percentage of Amylose Content from Local Sweet Potatoes from Several Countries (w/w %)	31
Table 4.3	Proximate Composition of Starches from 5 Varieties of Sweet Potatoes Compared to Potato Starch	33
Table 4.4	Proximate Composition of Starches from 3 Varieties of Chinese Sweet Potato	35

LIST OF FIGURES

Figure 2.1	Partial Structure for Amylose	13
Figure 2.2	Partial Structure for Amylopectin	14
Figure 4.1	The Swelling Behavior of 5 Sweet Potato Starches and Potato Starch as Influenced by Temperature	36
Figure 4.2	The Solubility Properties of 5 Sweet Potato Starches and Potato Starch as Influenced by Temperature	36
Figure 4.3	Syneresis of 5 Sweet Potato Starches as Compared With Potato Starches With Freeze-thaw Treatment	39
Figure 4.4	Syneresis of 5 Sweet Potato Starches as Compared With Potato Starches Without Freeze-thaw Treatment	39

LIST OF APPENDIX

Appendix 1	Swelling Power of Starches from Various Varieties of *Ipomoea batatas*	53
Appendix 2	Solubility of Starches in Water from Various Varieties of *Ipomoea batatas*	54
Appendix 3	Syneresis of 5 Sweet Potato Starches as Compared To Potato Starches With Freeze-thaw Treatment	55
Appendix 4	Syneresis of 5 Sweet Potato Starches as Compared To Potato Starches Without Freeze-thaw Treatment	56

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ABSTRAK

Sifat fizikiokimia kanji daripada lima varieti ubi keledek (*Ipomoea batatas*) telah diselidiki dan dibandingkan dengan kanji kentang. Di antara parameter yang telah diselidiki adalah peratusan kanji, kandungan amilosa, kandungan proksimat, sifat pengembangan dan kelarutan serta sineresis. Julat peratusan kanji daripada lima varieti ubi keledek adalah 23.2%-29.7%. Ubi keledek varieti 4 telah memberikan peratus kanji yang tertinggi (29.7%) manakala ubi keledek varieti 3 memberikan peratus kanji yang terendah (23.2%). Julat kandungan amilosa adalah 20.13%-25.73%. Kandungan amilosa bagi Ubi keledek varieti 5 adalah tertinggi (25.73%) manakala Ubi keledek varieti 3 memberikan kandungan amilosa terendah (20.13%). Julat bagi kandungan kelembapan adalah 8.76%-9.05%. Kandungan kelembapan daripada kanji Ubi keledek varieti 4 adalah tertinggi (9.05%) manakala kanji Ubi keledek varieti 1 adalah terendah (8.96%). Julat bagi kandungan abu adalah 0.47%-0.52%. Ubi keledek varieti 3 memberikan kandungan abu tertinggi (0.52%) dan kandungan abu paling rendah adalah Ubi keledek varieti 4 (0.47%). Julat kandungan lipid bagi kesemua sampel kanji Ubi keledek adalah 0.09%-0.12%. Ubi keledek varieti 2 memberikan kandungan lipid tertinggi (0.12%) manakala Ubi keledek varieti 3 memberikan nilai terendah (0.09%). Julat kandungan protein adalah 0.17%-0.19%. Ubi keledek varieti 4 memberikan kandungan protein tertinggi (0.19%) manakala Ubi keledek varieti 1 memberikan kandungan protein terendah (0.17%). Kanji Ubi keledek varieti 3 telah menunjukkan sifat pengembangan yang tertinggi di antara semua sampel kanji ubi keledek pada julat suhu yang telah ditetapkan manakala Ubi keledek varieti 5 menunjukkan nilai yang terendah di antara semua sampel kanji. Bagi sifat kelarutan, Ubi keledek varieti 5 memberikan nilai kelarutan tertinggi dan kelarutan paling rendah ditunjukkan oleh Ubi keledek varieti 3 pada julat suhu yang ditetapkan. Ubi keledek varieti 5 memberikan nilai sineresis yang tertinggi manakala Ubi keledek varieti 3 memberikan nilai sineresis yang paling rendah bagi kesemua sampel kanji ubi keledek.

Kata kunci: ubi keledek, kandungan proksimat, amilosa, kelarutan dan pengembangan, sineresis

ABSTRACT

The physicochemical characteristics of five sweet potato varieties were studied and compared to potato starch. The parameters studied were starch yield, amylose content, proximate content, swelling power and solubility and syneresis. The starch content of five sweet potato varieties ranged between 23.2%-29.7%. The Ipomoea batatas variety 4 gave the highest yield of starch (29.7%) while Ipomoea batatas variety 3 gave the lowest yield (23.2%). The amylose contents ranged between 20.13%- 25.73%. Amylose content of Ipomoea batatas variety 5 was the highest (25.73%) while starch from Ipomoea batatas showed the lowest amylose content (20.13%). The moisture contents ranged were 8.76%-9.05%. The moisture content of Ipomoea batatas variety 4 was the highest (9.05%) and the lowest was Ipomoea batatas variety 1 (8.76%). The ash content varied between 0.47%-0.52%. Ipomoea batatas variety 3 showed the highest ash content (0.52%) and the lowest ash content was found for Ipomoea batatas variety 4 (0.47%). The lipid content varied between 0.09%-0.12%. Ipomoea batatas variety 2 gave the highest lipid content (0.12%) while the lowest was found for Ipomoea batatas variety 3 (0.09%). The protein contents were in the range of 0.17%-0.19%. Ipomoea batatas variety 4 gave the highest protein content (0.19%) while Ipomoea batatas variety 1 gave the lowest protein content (0.17%). The swelling power of Ipomoea batatas variety 3 starch was the highest among all samples of sweet potato starches at all the temperature ranged studied while Ipomoea batatas variety 5 showed the lowest swelling power. For solubility, it was found that Ipomoea batatas variety 5 showed the highest solubility and the lowest was found for Ipomoea batatas variety 3 at all the temperature ranged studied. Syneresis for Ipomoea batatas variety 5 starch was the highest while Ipomoea batatas had the lowest value of syneresis tendency among the sweet potato starches studied.

Keywords: *sweet potato, starch, proximate content, amylose, swelling and solubility, syneres*

CHAPTER 1

INTRODUCTION

1.1 Introduction

Starch is a biopolymer composed of anhydroglucose units and is the major storage energy in various plants in nature. Starch exist widely in cereal grain seeds such as corn, wheat, rice, sorghum; tubers such as potato; roots such as sweet potato, arrowroot; legume seeds such as peas, beans, lentils; fruits such as green bananas, unripe apples, green tomatoes; trunks such as sago palm and leaves such as tobacco. Starch granules are composed of two major polymers known as amylose and amylopectin. Their structures and the relative amount of both polymers play an important function in the physicochemical properties of starch. Amylose which makes up 20–30% of normal starch is primarily a linear chain of D-glucose units linked by α-(1→4) linkages (Takeda *et al.*, 1990). The precise location of amylose within the granule is thought to be found predominantly in the amorphous, less-crystalline regions (Hizukuri, 1996).

Amylopectin is the major component of starch which comprises of 70–80%. It is a highly branched which consists of short chain of α-(1→4) linked α-D-glucose and about 5% of the glucose units are joined by α-(1→6) linkages (Takeda *et al.*, 1990). Amylopectin is a high molecular weight polymer. The presence of branch points within amylopectin allows the short linear chains to pack together efficiently as parallel left-handed double helices, forming the basis of the semi crystalline starch granule (Hizukuri, 1996). Amylose and amylopectin content varies according to botanical sources. For example corn starch has approximately 28% amylose, genetically manipulated high amylose corn starch can contain about 70% amylose while genetically modified waxy corn contains 90%–100% amylopectin (Kennedy *et al.*, 1983;

Cowburn, 1989). Starch granules naturally exist in different ranges of size distribution, different shapes and dimensions which depend on their botanical source, growing and harvest conditions.

Starch has always been an important item in the human diet. Starch is usually added to foods as thickener, binder, adhesive, gelling agent, stabilizer, texturizer, fat-replacer or processing aid in industrial application. Due to the sub-optimal behavior of native starch, modification of starch is the efficient way to provide starch products with suitable properties to meet the needs for specific uses. The commonly used modified starches are pregelatinized starch, oxidized starch and crosslinked starch (Eliasson and Gudmundsson, 1996). Starches or their derivatives can be used in food as a major ingredient or as an additive to optimize processing efficiency and product quality. In food industry, starches or starch derivatives are applied in bakery products, desserts, puddings, soups, sauces, beverages, meat products, dairy products and various products (Sudhakar *et al.,* 1995; Yackel and Cox, 1992).

Sweet potatoes (*Ipomoea batatas*) are originated from Central America and now they are cultivated throughout tropical and warm temperate regions wherever there is sufficient water to support their growth. The world production of sweet potatoes are 136 millions tons and the majority comes from China with a production of 114 millions metric tons (>80% of world production) from 49,000 km^2 (Woolf, 1992; FAO, 2001). Starch manufacture is the main industrial utilization of sweet potatoes which has been broadly used in starch noodles, bakery foods, snack foods (Palomar *et al.,* 1981; Wanjekeche and Keya, 1995), and for the alcohol production (Palomar *et al.,* 1981; Wanjekeche and Keya, 1995). The starch content of sweet potatoes can vary between 6.9-30.7% (Tian *et al.,* 1991).

1.2 Objectives

Several varieties of normal sweet potatoes are available in Malaysia, but the physicochemical properties of the starches are not well studied. Therefore, the objective of this research is to study the physicochemical properties of five varieties of sweet potato starches. Some of the parameters that will be studied include:

a) the percentage of starch of *Ipomoea batatas*

b) the proximate content

c) amylose and amylopectin content

d) swelling and solubility properties

e) retrogradation properties -syneresis

The physicochemical properties of the sweet potato starches will be compared to commonly used starch from potato.

CHAPTER 2

LITERATURE REVIEW

2.1 Source and Isolation

Starch is a mixture of two polymers, amylose, which is a linear chain of D-glucose units linked by α-(1→4) and amylopectin is a highly branched molecule which consists of short chains of (1→4)-linked by α-D-glucose with α-(1→6) linked branches (Takeda *et al.*,1990). As compared to amylose, the amylopectin structure is more complex since 4-5% of the total linkages form branches (Zhenghong, 2003). The degree polymerization of amylose is around 150,000 and 600,000 Dalton (Kennedy *et al.,* 1983). Figure 2.1 is a partial structure for amylose (http://www.Isbu.ac.uk/water/starch.html):

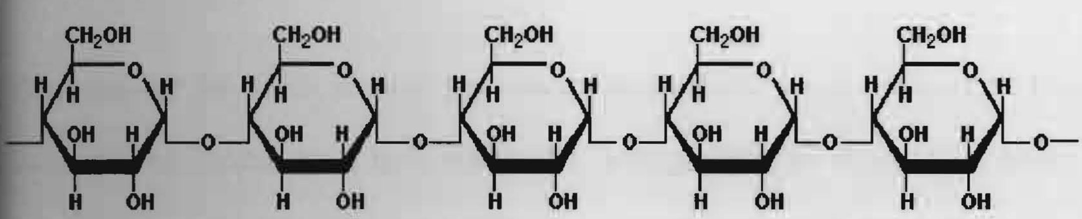

Figure 2.1 Partial Structure for Amylose

Amylopectin is very branched with an average of 17–26 D-glucosyl units separating the α-(1→6) branch points (Kennedy *et al.,* 1983). The molecular size of amylopectin is too large to be determined accurately but light scattering studies indicate a value of 10^6 D-glucosyl residues per molecule which makes amylopectin one of the largest naturally occurring macromolecules (Kennedy et *al.,* 1983). The ratio varies with the starch source, but it is typically 20:80 amylose to amylopectin (Orford *et al.,* 1987). Figure 2.2 is partial structure for amylopectin (http://www.lsbu.ac.uk/water/starch.html):

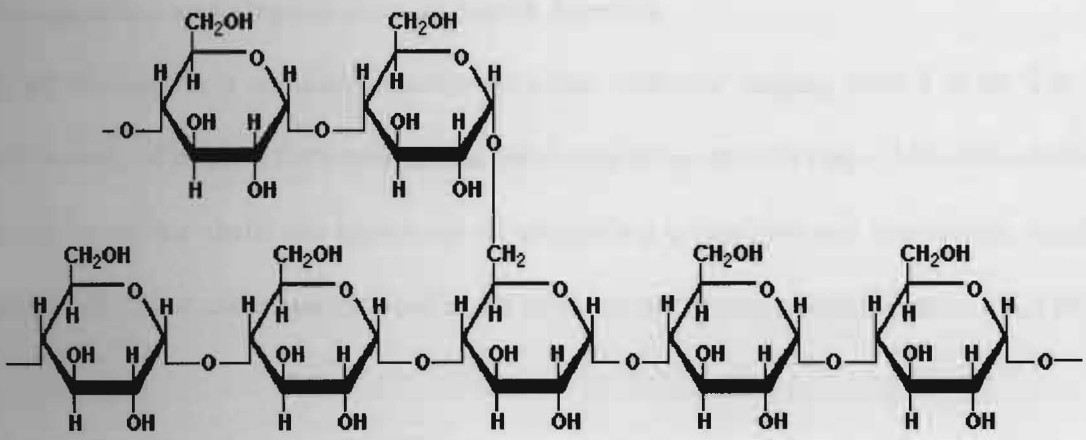

Figure 2.2 Partial Structure for Amylopectin

In general, cereal such as corn, wheat and rice contain relatively high levels of lipids (0.2-0.8%) and protein (0.2-0.5%). Tuber such as potato and root such as sweet potato starches have lower levels of lipids (0.1-0.2%) and protein contents (0.1-0.2%).

The purity of the starch isolated from sweet potato roots varies between 88.1 and 99.8%. Sweet potato starches have been reported to retrograde more slowly than wheat and corn starches but similar to potato starch (Del Rosario and Pontiveros, 1983; Takeda *et al.,* 1986) and the amylose content ranges from 8.5 to 37.4% (Takeda *et al.,* 1986; Tian *et al.,* 1991; Madhusudhan *et al.,* 1992; Collado and Corke, 1997; Garcia and Walter, 1998; Oduro *et al.,* 2000). The degree polymerization of sweet potato amylose is in the range of 3025 to 4100, while for amylopectin the average of chain length is 21-29 (Hizukuri, 1985; Takeda *et al.,* 1986; Ong *et al.,* 1994).

2.2 Composition and Organization of Starch Granule

Starch accumulates as a complex granular structure with size ranging from 1 to 60 μm. The granule is made of stacks of amorphous and semi-crystalline growth rings (120–400 nm thick). The semi-crystalline shells are composed of alternating crystalline and amorphous lamellae repeating in 9–10 nm and superimposed to the architecture of amylopectin (Lee *et al.*, 1991).

Starch granules naturally exist in different ranges of size distribution, different shapes and dimensions which depend on their botanical source, growing and harvest conditions. The granule size varies from the tiny granules in rice and oat starches (1.5-9μm) to the large ones in potato starch (up to 100 μm). Some cereal starches such as wheat, rye and barley show a bimodal size distribution and the broadest distribution is found for potato starch. The small granules (called B-granules) are spherically shaped with a diameter below 10 μm and the large granules (called A-granules) are lenticular with a diameter around 20 μm (Eliasson and Gudmundsson, 1996). The granule dimensions and shape descriptions of some starches are given in Table 2.1. Since the morphological characteristics show significant difference, most starches can be identified from their appearance under a light microscope (Fitt and Snyder, 1984).

Table 2.1 Characteristics of Some Starch Granules

Starch	**Diameter range (μm)**	**Average diameter (μm)**	**Shape**
Corn	2-30	10	Round, polygonal
Waxy corn	3-26	10	Round, polygonal
Wheat	1-45	8	Round, lenticular
Potato	5-100	28	Oval, spherical
Tapioca	4-35	15	Oval, truncated

Source: Swinkels, 1981

sweet potatoes differed in granule size and particle size distribution as well as in protein, lipid and phosphorus contents but the amylose contents were very consistent (19.3-20.0%) (Tang *et al.*, 2001a; 2001b). Generally, sweet potato starch granules vary from 4 to 40 microns with 19 micron in average and the amylose content is 19% to 25% (http://home3.inet.tele.dk/starch/isi/starch/Sweetpotato.htm). Large-size granule fractions were found to be more susceptible to chemical and enzymatic hydrolysis (Farmakis *et al.*, 2002). Small-size granule fractions of barley had lower amylose contents than their larger fractions (Takeda *et al.*, 1999; Tang *et al.*, 2001b).

However, no significant difference in amylose content was found for large and small size granule fractions of potato starch. The small-size granule fraction of potato starch had higher phosphorus content (Kainuma *et al.*, 1978). Fortuna *et al.*, (2000) observed that large-size granule fractions of potato and wheat starches produced solutions having higher viscosity than small-size granule fractions. The difference was explained by the higher swelling capability of large granules and the higher resistance of small granules to external factors (Chen, 2003).

2.3 Gelatinization

Gelatinization is the process of granule swelling followed by disruption of granule structure in which the loss of crystalline order can be observed by the disappearance of the X-ray diffraction. The process is manifested by changes such as granule swelling, native crystallite melting, loss of birefringence, and starch solubilization (Atwell *et al.*, 1988). The temperature at which gelatinization occurs is known as gelatinization temperature. Gelatinization temperature is depend on various factors such as starch concentration, pH of the suspension, te of heating and the specific procedure being followed. The gelatinization usually occurs ver a temperature range of 10-15°C (Evans and Haisman, 1982).

oot and tuber starches gelatinize at relative low temperatures, with rapid and uniform welling of granules. They also exhibit a high viscosity profile compared to cereal starches Craig *et al.*, 1989). Potato starch from tubers with a shorter growth time contributed to a igher peak temperature of gelatinization due to the smaller granule structure and the presence f lipids (Liu *et al.*, 2003). Sandhu *et al.* (2004) observed that the gelatinization temperature f normal corn starches ranged from 64.0 to 68.9°C. The gelatinization temperatures of the at starches ranged from 56.0 to 74.0°C and the gelatinization enthalpy is between 12.4 to 4.6 J/g (Hoover *et al.*, 2003). The corresponding values for sweet potato starches are in the ange of 58 to 84°C and 10.0 to 16.3 J/g, respectively (Takeda *et al.*, 1986; Zobel 1988; Tian t *al.*, 1991; Garcia and Walter, 1998; Collado *et al.*, 1999). Major differences in gelatinization temperature occur according to the soil temperature during the development of sweet potato tuberous roots (Takahiro, 1998).

2.4 Pasting Properties

The pasting properties of starches are very important for the starch characterization and applications. Useful information such as pasting temperature, peak viscosity, breakdown and setback values can be obtained from the profiles determined with Brabender amylograph or Rapid Visco Analyzer (RVA). Pasting properties are influenced by the amount of starch lipid content and the magnitude of interactions between starch chains within the granule interior (Hoover and Vasanthan, 1992; Wang and White, 1994). Starch found in tubers and roots xhibit a high paste clarity compared to cereal starches (Craig, 1989). Generally, phosphorus ontent had a stronger impact on the pasting properties of potato starch than amylose content.

.5 Retrogradation Properties

During storage, starch pastes may become cloudy and eventually deposit as an insoluble white precipitate. This is caused by the recrystallinization of starch molecules which is known as etrogradation. In the retrogradation process, the amylose forms double helical chain segments followed by helix-helix aggregation (Biliaderis, 1992). Amylose is considered primarily esponsible for the short-term retrogradation process due to the fact that the dissolved amylose molecules reorient in a parallel alignment. The long-term retrogradation is represented by the slow recrystallization of the outer branches of amylopectin (Miles *et al.*, 1985; Ring *et al.*, 1987; Daniel and Weaver, 2000). The recrystallized amylopectin in the retrograded gel can be melted at 55°C, whereas for the recrystallized amylose the melting temperature rises to 130°C (Zhang and Jackson, 1992).

Basically, the rate and the extent of retrogradation increase with an increased amount of amylose (Chen, 2003). In addition to the origin of starch, retrogradation also depends on starch concentration, storage temperature, pH, temperature procedure and the composition of the starch paste. Retrogradation is generally stimulated by a high starch concentration, low storage temperature and pH values between 5 and 7 (Chen, 2003).

.6 Modified Starch

Due to retrogradation and syneresis properties, the applications of native starches are restricted. In order to improve their functionality, starches that has been altered through chemical or enzyme modification and/or physical treatment is known as modified starch. Modification is achieved by transforming native starch through a range of processes including heat treatment, changes in pH, or by subjecting starch to enzymes and additives. Although modified starch resembles native starch in appearance, modification enhances the performance of the starch by improving specific functional qualities such as gelatinization temperature, paste clarity, viscosity, and film-forming ability.

Acetylation of starches is an important substitution method that has been applied to starches that impart the thickening needed in food application. Acetylated starch is a granular starch ester with the CH_3CO group introduced at low temperature (Narpinder *et al.*, 2004). Acetylated starches with low degree of substitution (DS) are widely used in food industries for many years because of important characteristics such as low gelatinization temperature, high swelling and solubility, and good cooking and storage stability (de Graaf *et al.*, 1998; Liu *et al.*, 1999; Wang and Wang, 2002). The acetylated starches are also less susceptible to retrogradation. Non-food applications of acetylated starches include wrap-sizing for textiles and surface-sizing for papers and gummed tape adhesives (Sanford and Baird, 1985).

The physicochemical properties of acetylated starches depend on their chemical structures, degree of substititon (DS) and acetyl group distributions. Biliaderis (1992) reported that high substitution exists only in certain parts of the amylopectin of acetylated starch and acetylation smooth pea starch occurred exclusively in the outer lamella of the granules. The substitution with acetyl groups reduced the degradability of acetylated starch by α-amylase (Oestergard *et al.,* 1988). For highly acetylated starches NMR analysis showed that the glucose residues are equally substituted in O-2 and O-3 position, while for hydroxyethyl starches the position O-2 is highly preferred (Heins *et al.,* 1998).

Oxidized starches are widely used in industries such as food applications where high solids, low viscosity and a creamy body are desired, such as in bakery fillings; paper industry as tub, size press and calendar sizes and in the textile industry as components in adhesives. Although these starches are being used since many decades, their structural changes and the mechanisms of reaction are still not well understood, mainly when considering low levels of oxidants (Wang and Wang, 2003). The oxidative treatment affects the starch viscosity and the paste stability (Forssell *et al.,* 1995). Oxidized starch pastes are relatively clear and show a reduced tendency to thicken or set back when cooled. When dried, oxidized starch films are clear and tough. Because the highly oxidized starches give relatively clear pastes at high solids, they are sometimes referred to as gums.

2.7 Starch from *Ipomoea batatas*

The sweet potato (*Ipomoea batatas*) is a crop plant whose large, starchy, sweet-tasting tuberous roots are an important root vegetable. The young leaves and shoots are sometimes eaten as greens. The plant is an herbaceous perennial vine, bearing alternate heart-shaped or palmately lobed leaves and medium-sized sympetalous flowers (http://en.wikipedia.org/wiki/Sweet_potato). The edible tuberous root is long and tapered, ith a smooth skin whose color ranges between red, purple, brown and white. Its flesh ranges tween white, yellow, orange and purple.

veet potato originated from Central America, and widely cultivated and consumed roughout the world. Sweet potato has been recognized as an important food crop having a gh yield during a fairly short harvest season (about 3-5 months), and having a good laptability to varying climatic and field conditions (Tian *et al.*, 1991; Woolf, 1992).

hina is the leading country of sweet potato production (Ishida *et al.*, 2000). Sweet potato ıltivated mainly for the tuber, used as vegetable, eaten boiled, baked fried, or dried and ound into flour to make biscuits, bread, and other pastries. Tubers also dehydrated in chips, anned, cooked and frozen, creamed and used as pie fillings, much like pumpkin. Greatly steemed as feed for farm animals; with 3 kg green sweet potatoes equivalent to 1 kg of corn, ith a food value rated 95–100% that of corn. Dry vines have feed value which compares ıvorably with alfalfa hay as forage (Reed, 1976).

here has been a strong desire from the sweet potato farmers and processors to increase their venue by adding economic value to the sweet potato products. Until now, starch is the main ıdustrial product from sweet potatoes but its use is still limited (Jangchud *et al.*, 2003). The mited industrial application for sweet potato starch is considered to be partly due to npurities and lack of information about its properties (Narayana-Moorthy, 2002).

ecently, several studies have focused on using sweet potato starches substitution for ungbeen or edible canna starches to produce the transparent noodle with reduction the price f product in Vietnam (Collado and Corke, 1997; Kasemsuwan *et al.*, 1998). However, noodle ıde from native cassava or sweet potato starch had an inferior quality. Chemical ›dification might improve the noodle quality of these starches.

ıe chemical compositions of the typical Chinese sweet potato starches were found to be nilar to those reported from Indian, Japanese, and USA sweet potato varieties (Table 2.2). ıe amylose, protein, and lipid contents of Nigerian sweet potato varieties are extremely gher. This might be due to both the variety and the growing condition (Madhusudhan *et al.*, ›92; Osundahunsi *et al.*, 2003; Takeda *et al.*, 1986; Garcia and Walter, 1998; McPherson and ıne, 1999).

able 2.2 Chemical Compositions of Isolated Starch from Local Sweet Potato Varieties from arious Countries (w/w %)

ource	Amylose (db)	Protein (db)	Lipids (db)	Phosphorus (db)
hina(XuShu18)	20.00	0.23	0.21	0.02
hina(XuShu2)	19.30	0.14	0.14	0.01
hina(XuShu8)	19.60	0.17	0.16	0.02
ıdia ocal varieties)[1]	17.00 -22.00	0.14-4.28	NA	0.05-0.05
ligeria TIS-1499)[2]	32.20	4.38	2.21	NA
ligeria TIB-2)[2]	34.20	5.56	2.28	NA
ıpan Koganesengan)[3]	18.90	0.04	NA	0.01
ıpan Minamiyutaka)[3]	17.20	0.05	NA	0.01
ıpan Norin-2)[3]	19.00	0.05	NA	0.01
JSA local varieties)[4]	22.80	NA	NA	0.02

lote: 1. Madhusudan *et al.*, 1992; 2. Osundahunsi *et al.*, 2003; 3. Takeda *et al.*, 1986; Garcia and Walter, 1998; . McPherson and Jane, 1999; NA: not available; Db: dry base

'he granule sizes of sweet potato starches are quite heterogeneous with a broad granule size istribution as shown in Table 2.3.

ble 2.3 Physicochemical Properties of Isolated Starches from Sweet Potato Varieties from rious Countries

urce	Granule Size (μm)		Gelatinization temperature (°C)	Swelling power (90°C)	Syneresis (%)
	Range	Mean			
ina(XuShu18)	4-28	12	75	33	29
ina(SuShu2)	3-28	9	69	24	26
ina(SuShu8)	3-24	8	67	36	8
dia[1]	2-13	NA	67-75	NA	NA
igeria[2]	2-40	NA	66-75	56-58	NA
pan	NA	8.6-11.0[3]	72-76[3]	NA	NA
SA	3-60[5]	13.3-21.3[5]	62.8-71.4[5]	32-38[5]	NA

ote: 1. Local varieties (Madhusudhan *et al.*, 1992); 2. TIS-1499 and TIB-2 varieties (Osundahunsi *et al.*, 2003); Koganesengan and Shiroyutata varieties (Noda *et al.*, 1995); 4. Koganesengan, Minamiyutaka and Norin-2 rieties (Takeda *et al.*, 1986); 5. Jewel, Beauregard, NC10-28, NC2-26, NC6-30 and NC8-22 varieties (Walter *al.*, 2002); 6. Local variety (McPherson and Jane, 1999)

he granule sizes ranges of the Chinese sweet potato starches are narrower than those from igerian and USA varieties (Osundahunsi *et al.*, 2003; Walter *et al.*, 2002) but broader than ose from Indian varieties (Madhusudhan *et al.*, 1992). Studies towards the characterization f sweet potato starches are usually directed to the high starch content varieties, while arieties not used for starch production, like for consumption in roasted form and with much wer starch content are generally ignored. Other physical properties such as gelatinization emperature and swelling behavior of the Chinese sweet potato starches are quite comparable ith those found for the varieties from other countries.