Phytochemical examination and starch isolation from *Maranta arundinacea* Linn. (Ar-tar-lut-u)

Khin Thu Zar Myint[1],Sandar[2],Khin Thuzar[3]

ABSTRACT

Underground starchy plants namely *Maranta arundinacea* Linn. grown in Hinthada District were collected, calssified and identified. Most of them were cultivated for their consumption and also for economical purpose. The macroscopical and microscopical characters of rhizomes were examined. Preliminary phytochemical investigations were also studied. Nutritive values and elemental determination were analyzed. In nutritional studies, *Maranta arundinacea*Linn. was found as high fiber content. It was about 6.435%. So, *Maranta arundinacea* Linn. was good source for fiber diet in human health. In addition, medicinal, nutritional and economical usefulness of maranta starch or arrowroot starch was isolated from fresh rhizome of *Maranta arundinacea* Linn. Yield percentage, characteristic of starch and gelatinization temperature were studied. Yield percentage of starch was 15.01% and waste product of starch isolation was 8.89% respectively. Waste products of maranta starch isolation were also used for animal feed. Amylose and amylopectin contents of isolated starch were determined by using UV visible spectrophotometric method. Amylose content was 20.29% and amylopectin was 79.71% respectively. Maranta starch was highly digestable and very popular in world starch trade level.

Keywords: *Maranta arundinacea* Linn, rhizome, nutritive value, fiber, starch

Introduction

Myanmar is endowed with many natural resources due to her unique geographical position and favorable climate. Natural resources like water resources, forest and plant are abundant. Underground plant resources are well grown in whole country of Myanmar.

Underground plant resources such as roots, tubers and rhizomes are next to cereals and pulses in term of their economic and nutritional importance as human food resource (FAO, 1994). Carbohydrate, the energy providing food is found to be needed 3050 Kcal for daily consumption of diet for human adults. (WHO, 1985).

Starch, long chain polysaccharide is the major constituent of the carbobydrate. Starch and their product are widely used and they form part of most of the things which are necessary in everyday life of this modern world. It is used in food industry, textile industry, foundary industry, adhesives and oil well drilling. Moreover, maranta starch or arrowroot starch is extensively used in food and medicinal application.

Maranta arundinacea Linn is well known as Ar-tar-lut-u, War-u, Thin-u in Myanmar and widely grown for their edible purpose. English name is Arrowroot. So, isolation of maranta starch was carried out from fresh rhizome of *Maranta aroundinacea* Linn. Starch production should be increased in order to meet the food and industrial demand of increasing population and might become one of the leading earners of foreign exchange for Myanmar.

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Material and Methods

Collection and morphological characterization

The plant specimen was collected in Hinthada District during the flowering and fruiting periods. Identification was observed by using Purseglove, 1972.

Macroscopical and microscopical characterization

Specimen was sectioned by free hand for microscopical studies with special emphasis on starch distribution. Macroscopical characters were studied by the method of Trease and Evans, 1978.

Preliminary phytochemical examination and physicochemical characterization

Phytochemical examination of powdered sample has been conducted with the method of Harbone, 1989. Physicochemical characterization has been examined with the method of W.H.O,1998.

Nutritive value and elemental determination

Carbohydrate, protein and fat contents have been determined in the laboratory of Pharmaceutical Research Department, Myanmar Scientific and Technological Research Centre. Fiber content has been carried out in Cottage Industries Department, Ministry of Co-operative. Vitamin B_1 and vitamin C contents have been determined in National Nutrition Centre. Elemental analysis of powdered sample by using EDXRF spectrophotoscopy has been analyzed at Universities Research Centre, University of Yangon.

Starch Isolation

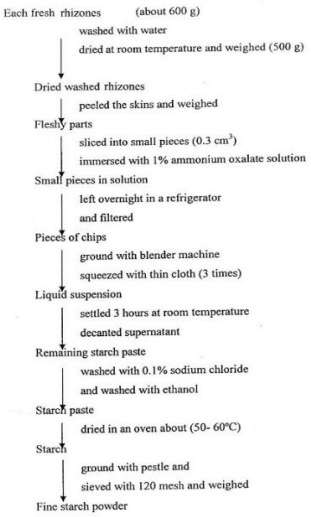

Fig 1 Flow chart for starch isolation

Identification and characterization of isolated starch

Isolated starch 1 gm was mixed with 15 times its weight of water and boiled. When the solution was cooled, a translucent viscous fluid was obtained. When iodine reogent solution was added, a deep blue colour was observed. The blue colour disappeared on boiling and reappeared on cooling. Microscopic examination of isolated starch was made by using light microscope.

Gelatinization Temperature and Amylose and Amylopectin determination

The gelationization temperature of isolated starch was carried out by Kerr's, 1950. The amylose content of isolated starch was determined by the method of Kerr and Turbell, 1993.Light absorbance of isolated starch solution was measured at 680 nm in using UV-visible spectrophotometer. A standard curve was drawn between light absorbances and composition of amylose-amylopetin.

Table 1 Absorbance measured at 680 nm for iodine-stained mixtures of amylose-amylopectin

Composition		Wave Length (nm)	Absorbance measured
% Amylose	% Amylopectin		
0	100	680 nm	0.022
20	80	680 nm	0.102
40	60	680 nm	0.184
60	40	680 nm	0.265
80	20	680 nm	0.345
100	0	680 nm	0.428

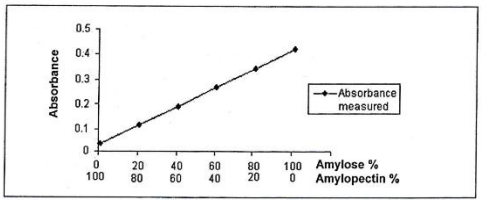

Fig 2 Standard curve of light absorbances of 680 nm against compositionof iodine-stained amylose-amylopectin

Results

Scientific Name - *Maranta arundinacea* Linn
Myanmar Name - Ar-tar-lut-u, Thin-u, War-u
English Name - Arrowroot
Family - Marantaceae

Morphological diagnostic characters

Erect annual perennial herbs, 0.5-1.0 m high, fleshy, subcylindrical, creamish white rhizome with thin scales. Leaves radial or cauline, sheath and blade present: leaf blade ovate lanceolate, leaf-sheath clapping stem. Inflorescence axillary panicle, peduncles green, glabrous, 2-4 cm long 1-2cm wide; bract linear lanceolate. Flower bisexual, irregular, white. Calyx lobe 3, free, lanceolate, green. Corolla 3, lobe and tube present, lobe unequal, white. Androecium 2 series, outer cycle 2 large petaloid staminode (posterior), inner cycle 1 fertilestamen (anterior); anther lanceolate, the style sunken in the staminode; stigma 3 lobed, style curved; ovary inferior 3 celled, sometime 2 are aborted. Fruit not seen.

Fig 3 close-up view of plants habit

Fig 4 view of cultivated plants in natural habit

Fig 5 close-up view of inflorescense

Fig 6 close-up view of flowers

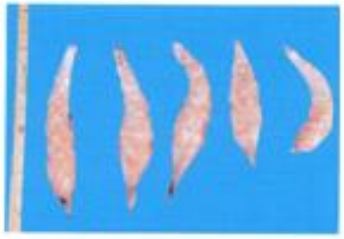

Fig 7 close-up view of rhizomes

Macroscopical characters of rhigome of Maranha arundinacea Linn

In transverse section, the rhizome is circular in outine. Epiblema is a single layer. The cells of cpiblema are thin walls, starch free pharenchymatous. Ground tissue consists of the parenchymatous with intercellular spaces and starch abundantly occur. Vasular bundles are irregularly scattered in the ground tissues. Outer and inner ground tissue are divided by distinct endodermal layer. Most bundles are collateral types but some of which are enclosed by complete fibrous sheath. Vascular bundles of inner ground tissue occur as more congested than those of outer vascular bundles and most of which are xylem pole only. The distribution of sharch is more abundant in the outer ground tissues.

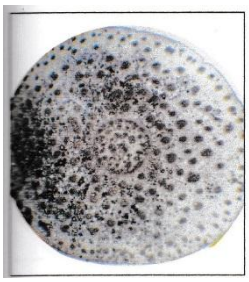

Fig 8T.S of rhizome (x 100)

Fig 9 Outer regions of rhizome (x 200)

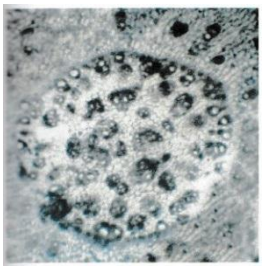

Fig 10 Inner regions of rhizome

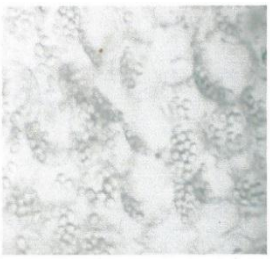

Fig 11 Close-up view of cells with starchgrains (x 400)

Table 2 The macroscopical characters of rhizome of *Maranta arundinacea* Linn.

S.N	Sample	Part used	size	shape	surface characters	character in T.S
1	*Maranta arundinacea* Linn.	Rhizome	L=10-18cm B=2-4cm	sub spindle	creamish white with hodes and internodes, dry scales leaves	creamish white

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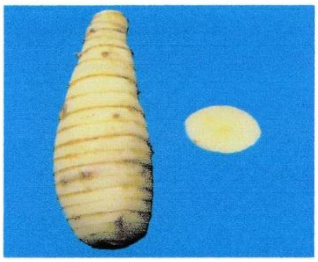

Fig 12*Maranta arundinacea* Linn.

Table 3 The microscopical characters of powdered sample

S.N	Sample	Fragment of epidermal cell	Starch grains	Fragment of fiber	Vessel element
1	*Maranta arundinacea* Linn.	50-60µ	abundant	L=80-200µ B=6.0-8.0µ	L=85-190µ B=25-30µ

Fig 14 Starch grains (x 400)

Fig 15 Fiber (x 400)

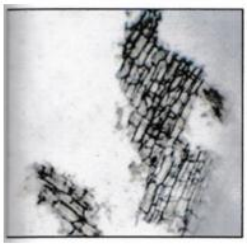

Fig 13 Fragment of epidermal cell (x 400)

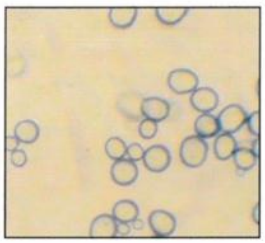

Fig 14 Starch grains (x 400)

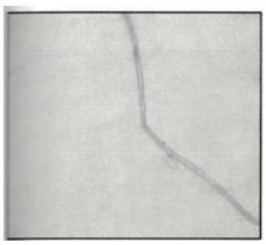

Fig 15 Fiber (x 400)

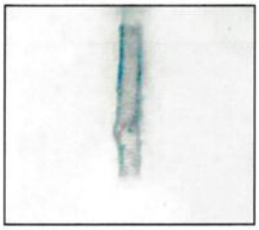

Fig 16 Vessel element (x 400)

Preliminary phytochemical examination and physicochemical characterization

Table 4 Preliminary phytochemical examination

No	Types of Product	Test reagent	Observation	*Maranta arundinacea* Linn.
1	Starch	I_2 solution	Blue black ppt	+
2	Carbohydrate	10% α Naphthol, Conc: S/A	Red ring	+
3	Saponin	Distilled water	Frothing	+
4	Reducing sugar	Benedict's solution	Brick-red ppt	+
5	α amino acid	Ninhydrin regent	Pink purple	+
6	Glycoside	10% lead acetate	White ppt	+
7	Alkaloid	Mayer's reagent Dragendroff's reagent	White ppt Orange ppt	+
8	Steroid	Benzen, Acetic anhydride and Con: S/A	Green ppt	+
9	Phenolic compound	FeCL3 solution	No coloration	_
10	Cyanogenic glycoside	Con: S/A & sodium picrate paper	No coloration	_
11	Tannin	Ferri c chloride test	No coloration	_

+ Present, - Absent

Table 5 Physicochemical characterization

S.N	Physicochemical characters	Percentage
1	Water comtent (fresh tuber)	70.43
2	Mositure content of powdered sample	7.86
3	Total ash content	11.53
4	Water soluble matter content	3.52
5	Ethanol soluble matter content	2.43
6	Peteroleun soluble matter content	0.89

Nutritive values and elemental determination

Table 6 Nutritive values

S.N	Nutritional compoments	percentage
1	Carbohyfrate	27.74
2	Protein	2.1
3	Fat	0.1
4	Fiber	6.435
5	Vitamin B1	0.132mg
6	Vitamin C	7.00mg

Table 7 Elemental determination

S.N	Elements	percentage
1	K	0.864
2	Fe	0.04
3	Ca	0.054
4	Zn	-
5	Mn	0.004
6	CH balance	99.038

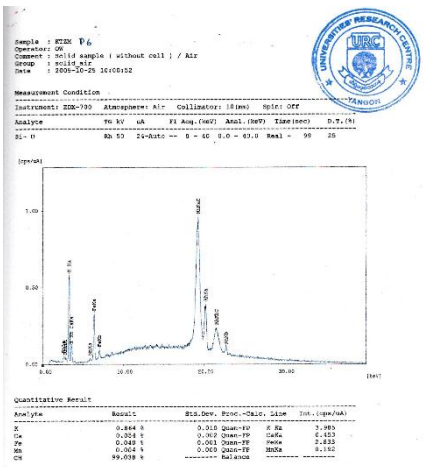

Fig 17 Elemental analysis of *Marantaarundinacea*Linn.

Starch isolation from freshy rhizome of *Marantaarundinacea* Linn.

Maranta starch was isolated from fresh rhizome by using Badenhuizen's 1984. Yield percentage of isolated starch was found as 15.01%. Percentage of waste product was 8.89% respectively.

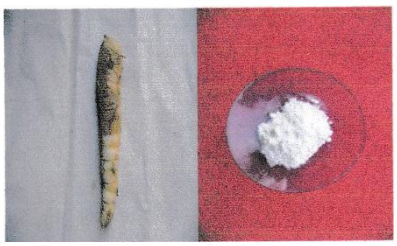

Fig 18 Isolated starch of *Marantaarundinacea*Linn.

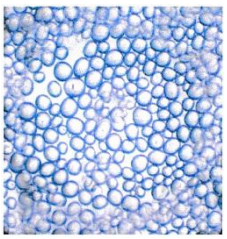

Fig 19 Starch grains of *Marantaarundinacea*Linn.

Identification and characterization of isolated starch

Isolated starch has been determined by using 2% iodine solution B.P. Iodine solution test indicated that sample was starch.

Table 8 characterization of isolated starch grains

Gelatinization temperature and amylose and amylopetin content determination

Gelatinization temperature of isolated starch was found as 72.26°C.

S.N	Sample	characters	size	shape	Position of hulum	striation
1	*Maranta arundinacea* Linn.	All simple grains	7.65µ	Ovoid to sub triangular	Split helium, strightly accentric	Fire concentric striation visible

Table 9 Amylose and amylopetin content of isolated starch by using UV visible spectrophotometric method.

S.N	Sample	Absorbance measured	Amylose content %	Amylopehin content %
1	*Maranta arundinacea* Linn.	0.097	19.51	80.49

Discussion and Conclusion

Maranta arundinacea Linn. was economically cultivated for nutritive values and famous for edible purpose.In microscopical studies, single layer epiblemawith lignified fibrous cell was present.Vascular bundles were irregularly scattered in outer and innerground tissues. The distribution of starch was more abundant in outer region of ground tissue. These characters were agreed with those mentioned by Timlinson, 1969.

Maranta starch was simple, avoid to subtriamgular,split and slightly accentric hium.These characters were inaccordance with those mentioned by Santa,1999 and Wicken,2001.In phytochemical studies, phenolic compound, cyanogenic glycoside and tannin were found to be absent. Starch, carbohydrate, saponin, reducing sugar, α amino acid, glycoside, alkaloid and steroid were found to be present.

In nutritional studies, Vitamin C content was found as 7.00mg.So,*Maranta arundinacea* Linn was good source for Vitamin C.Fiber content was found as 6.435%. It was excellent source for fiber diet in human health.In elemental studies, potassium content was found to be highest.It was useful for heart health.

Isolated starch was found as 15.0% and percentage of waste product was 8.89%. Maranta starch was used as baby powder, infant food,bio-yoghurt and food industry. Waste product of maranta starch was also used as animal feed and maranta fibers were very useful for health of pregnant women.Maranta starch was highly digestable and very popular in World starch trade level.

According to this research, high yielding cultivars of *Maranta arundinacea*Linn. should be widely cultivated with the organic fertilizer. Organic maranta starch, arrowroot starch should be produced and participated in to starch trade of international level to earn foreign currency for Myanmar.

Acknowledgements

We would like to express our deepest gratitude to Dr. Tin Htwe, Rector and Dr. Mar Lar, Pro Reactor of Hinthada University. We would like to thank to Dr. Thida Oo, Professor and Head and Dr. Wah Wah Myint, Professor, Botany Department, Hinthada University, for their kind permissions.

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