Physicochemical and microscopic properties of starch from perennating organs of wild species of *Amorphophallus sylvaticus* (Roxb.) Kunth

R. M. Mulani and Miss. C. V. Kondekar

DST-FIST, UGC-SAP Sponsored School of Life Sciences

Swami Ramanand Teerth Marathwada university, Nanded.

ABSTRACT

Physicochemical and microscopic properties of starches isolated from mature corm of *Amorphophallus sylvaticus* (Roxb.) Kunth found wild in the Marathwada have been given. The properties have been given and compared with corresponding properties of starch of market samples of *Amorphophallus campanulatus* (Roxb.) Blume ex Decne. and wild isolated starches of *Amorphophallus bulbifer* (Roxb.) Blume and *Amorphophallus commutatus* (Schott) Engl. (Mulani and Kulkarni 2000). The starch grains are smaller than market sample of *Amorphophallus Campanulatus* (Roxb.) Blume ex Decne. but bigger than that of *Amorphophallus bulbifer* (Roxb.) Blume and *Amorphophallus commutatus* (Schott) Engl.

Key words: *Amorphophallus sylvaticus*, Physicochemical, Microscopic properties, starch.

INTRODUCTION

Amorphophallus sylvaticus (Roxb.) Kunth is a monsoon perennial cormatus herb occur in forest of Marathwada. It produces flowers in month of May and June when there are no leaves. For the first time the starch properties have been investigated and compared with other species of *Amorphophallus* and market sample (Mulani and Kulkarni 2000). Starch is the storage reserve food in the plants mainly found in various plant parts such as seed, fruits, tubers and roots, while it is used as an energy source during regrowth and dormancy periods. Starch is versatile and useful polymer. The physicochemical properties are altered through physical, chemical treatments or enzyme modification. Starch is a very much important ingredients in different food systems such as thickenings, gelling and binding agents. (Abo-El-Fetoh *et. al.* 2010). The functional and chemical properties of isolated starch from tubers of *Amorphophallus paeoniifolius* (Dennst.) Nicolson. and *Dioscorea trifida* L. f. are acts as the important source of starch and starch as a major component. Functional properties like water, absorption capacity, oil absorption capacity, swelling capacity and chemical properties such as moisture content and dry matter are studied by Surendra Babu And Parimalavalli (2012).

Amorphophallus paeoniifolius (Dennst.) Nicolson. are highly potential tropical tuber crop and are rich in nutrients with containing low fat food as a good source of protein and starch. It is a natural product having large concentration of fibre, rich in potassium, calcium phosphorus, vitamin A, vitamin B6 and trace amount of minerals. The effect of osmotic substance, time, temperature of dehydration process on enzyme activity on Yam are studied by Singh and Wadhawa (2012). Reddy *et. al.* (2014) study the properties of resistant starch III prepare from elephant foot yam starch using pullulanase enzyme. The gelatinized and native starches are subjected to enzymatic hydrolysis, autoclaved and stored at 4^0c and then lyophilized and prepare resistant starch III. The characterization of resistant starch such as retrogradation, water absorption, solubility of water, swelling power, pasting properties, viscosity, recrystallization etc. are observed.

MATERIALS AND METHODS

Area of collection of plant material:

The source of plant material was collected from Pota, in Himayatnagar taluka from Nanded District of Maharashtra, India.

In Table 1 and 2, starch percentage on dry weight basis, isolation of starch by Willigen 1964, Starch bound protein, lipid and amylase percentage were determined using procedures suggested by Hoffpauir (1949); Knight (1965) and Mc Cready and Hassid (1943) respectively. Procedure of Brautlecht (1953) and Lampitt *et. al.* (1941) were followed for determination of pH and retrogradation; Methods recommended by Kerr (1950) were employed for determination of syneresis, viscosity and solubility at room temperature and those of Whistler (1964) for all other properties.

OBSERVATIONS

Properties of starches of different species of *Amorphophallus* have been tabulated in Table 1 and 2. Along with those of *Amorphophallus campanulatus* (Roxb.) Blume ex Decne. (Market sample). The starch grains of *Amorphophallus* species are characterised by shape polymorphism (fig. F-G). They are simple and compound, variable in shape i.e., round, triangular, trigonous. Hilum are radiating with distinct striation. The Graph shows the Granule diameter (μ m) vs percent (%) frequency.

Gelatinization temperature are ranges from 70^0C to 74^0C, in that starch granules are heated in excess of water and get hydrated as well as swollen, the tight association between amylose and amylopectin molecules are lost and grains lose their crystallinity (fig. D-E). Gelatinization effect on amylose and amylopectin ratio, lipid content and the size, Gelatinization temperature represents by range which is characteristic for starch taxon, on further heating of starch suspension above gelatinization temperature range, viscosity of

starch increases. The close comparison of starch properties of market sample of *Amorphophallus companulatus* (Roxb.) Blume ex Decne. with its wild counterpart reveals significant differences between the two indicating their genetic distinction.

Table-1: - Microscopic properties of starch from perennating organs in wild species of *Amorphophallus sylvaticus* (Roxb.) Kunth in comparison with that of market sample and other wild species of *Amorphophallus* and Potato starch.

Botanical names with Authors / **Properties of starch**	***Amorphophallus campanulatus*** (Roxb.) Blume ex Decne. market sample Mulla & Kulkarni (2000)	***Amorphophallus campanulatus*** (Roxb.) Blume ex Decne. Mulla & Kulkarni (2000)	***Amorphophallus commutatus*** (Schott) Engl. Mulani & Kulkarni (2000)	***Amorphophallus bulbifer*** (Roxb.) Blume Mulani & Kulkarni (2000)	Potato starch Naik & Mulani	***Amorphophallus sylvaticus*** (Roxb.) Kunth
Place of collection	----	Wangani (Thane)	Mumbra (Thane)	Matheran (Thane)	----	Pota (Nanded)
Starch (%) dry wt. basis	85	60	15	24	75	35
no/mg of starch	17,75,000	49,25,000	6,82,00,000	7,27,30,000	75000	2,90,00,000
Size (mm)	2-34 (6-16)	2-17 (3-9)	1-8 (2-4.5)	1-9 (2-8)	50-100	1-12 (3-5.5)
Type	Simple & compound	Simple & compound	Simple & compound	Mostly simple	Simple, few compound	Simple & compound
Shape	Variable	Variable	Variable	Variable	Variable	Variable
Hilum	Central	Central	Central	Central	Excentric	Radiating
Striation	Indistinct	Indistinct	Indistinct	Indistinct	concentric	Distinct

Table-2: - Physicochemical properties of starch from perennating organs in wild species of *Amorphophallus sylvaticus* (Roxb.) Kunth in comparison with that of market sample and other wild species of *Amorphophallus* and Potato starch.

Botanical names with Authors / **Properties of starch**	***Amorphophallus campanulatus*** (Roxb.) Blume ex Decne. market sample Mulla & Kulkarni (2000)	***Amorphophallus campanulatus*** (Roxb.) Blume ex Decne. Mulla & Kulkarni (2000)	***Amorphophallus commutatus*** (Schott) Engl. Mulani & Kulkarni (2000)	***Amorphophallus bulbifer*** (Roxb.) Blume Mulani & Kulkarni (2000)	Potato starch Naik & Mulani	***Amorphophallus sylvaticus*** (Roxb.) Kunth
Ash (%) Total	0.201	0.6	0.9	0.486	0.225	0.254
Acid insoluble	0.096	0.3	0.1	0.1	0.042	0.041
Acid soluble	0.105	0.3	0.8	0.366	0.182	0.213
Amylose (%)	51	34	20	17.83	21	35
Solubility % at R.T.	0.437	1.933	3.066	2.6	0.34	0.04
PH	6.60	6.51	6.35	6.39	6.5	6.8
Moisture (%)	9.476	10.5	7.0	10.1656	19.00	0.0 22
Starch bound lipid (%)	3.08	1.68	6.22	5.68	0.05	0.18
Starch bound protein (%)	0.121	0.125	0.125	0.118	0.06	0.100
Starch bound phosphorus (%)	0.010	0.012	0.012	0.010	0.08	----
Syneresis	1.253	1.783	1.28	1.37	0.98	0.95
Retrogradation 7^0 37^0 63^0	 87.3 87.5 91.0	 89.7 84.2 78.8	 87.5 81.7 83.1	 1.37 84.6 80.1	 86.2 83.0 79.3	 93.7 86.3 84.4
Gelatinization temp. range ^{0}C	75-82	74-78	82-85	80-85	54-60	70-74

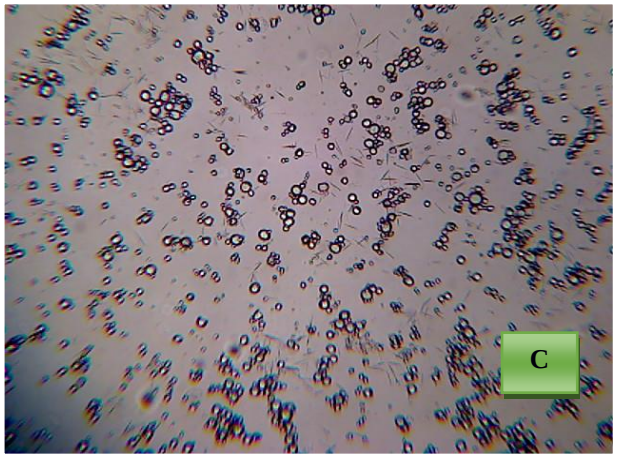
Viscosity (cps) at RT	1.204	1.193	1.243	1.305	1.672	1.185

A. Plant in natural habitat

B. Entire plant with inflorescence

C. Different size of Corms

D. Ungelatinized starch grains



E. Gelatinized starch grains

F. Starch grains 10x

G. Starch grains with circular striations.

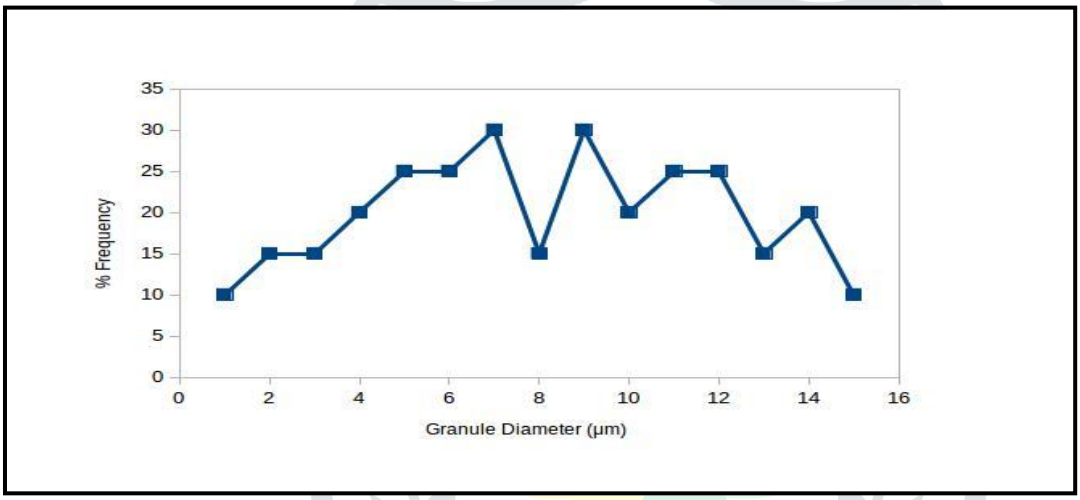


Fig. Graph of granule diameter (µm) vs % frequency.

RESULTS

Starch properties *of Amorphophallus sylvaticus* (Roxb.) Kunth were analysed and compared with other *Amorphophallus* species. The starch percentage is lower than market sample but higher than that of *Amorphophallus commutatus* (Schott) Engl. and *Amorphophallus bulbifer* (Roxb.) Blume. The starch grains were simple and compound variable with radiating hilum, striations indistinct. Size variable from 1 mm to 12 mm most of 2mm-5mm.

The physicochemical properties of *Amorphophallus sylvaticus* (Roxb.) Kunth are compared with the other *Amorphophallus* species (i.e. market samples) in that, the total ash is higher in *Amorphophallus sylvaticus* (Roxb.) Kunth i.e. 0.254% in that 0.041 are acid insoluble and 0.213% are soluble. The amylose is 35%. The solubility percent of starch at room temperature are 0.04%. It is very less. The PH is 6.8. The moisture percentage of starch is 0.220%. Starch bound lipids and starch bound protein 0.18% and 0.100%. Syneresis 0.95%.

The retrogradation at 7^0C, 37^0C and 63^0C are 93.7, 86.3 and 84.4 respectively. Gelatinization temperature range is 70^0-74^0C and viscosity is 1.185 cps at RT. The properties studied reveals that *Amorphophallus sylvaticus* (Roxb.) Kunth starch can be utilised as alternative source of starch.

DISCUSSION

Physicochemical and microscopic properties of isolated starch of corm of *Amorphophallus sylvaticus* (Roxb.) Kunth has been investigated first time.

Mulani and Kulkarni (2000) has analysed the market sample *Amorphophallus companulatus* (Roxb.) Blume ex Decne. and reported smaller sized starch grains, significantly higher count of starch grains, lesser percentage of starch, higher moisture percentage and lower lipid and amylose content. Though market sample analysed by Soni *et. al.* (1985) has revealed considerably low amylose content as compared to market sample analyse by Mulani and Kulkarni (2000).

Mulani and Kulkarni (2000) has studied starches of *Amorphophallus bulbifer* (Roxb.) Blume. and *Amorphophallus commutatus* (Schott) Engl. which are different from the wild sample of *Amorphophallus companulatus* (Roxb.) Blume ex Decne. in having significantly smaller starch grains with considerable higher counts of sample, lesser starch percentage, lesser amylose content, higher gelatinization temperature range and higher lipid content.

In wild sample of *Amorphophallus campanulatus* (Roxb.) Blume ex Decne., *Amorphophallus bulbifer* (Roxb.) Blume. and *Amorphophallus commutatus* (Schott) Engl. the retrogradation percentage starts to decrease with increase in temperature.

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