

Caryota Palm Sago ó A potential yet underutilized natural resource for modern starch industry

P Rajyalakshmi

Department of Foods & Nutrition, Postgraduate and Research Centre
ANGR Agricultural University, Rajendranagar, Hyderabad-500 030
E-mail: rajyalakshmi@yaho.co.uk

Abstract

A lot of interest is currently being focused on the possibilities of exploring the less familiar plant resources existing in the wild. *Caryota urens* is a semi-wild species traditionally managed and used in native dishes, often a principal food for tribals during lean season in many parts of South India. Sago obtained from this palm has greater potential for exploitation in starch based food industry. An easy and viable method of purification of sago for removal of colour and astringency goes a long way in its maximum utilization in food industry. Tropical countries should consider taking advantage of the unique properties of sago in the development of cost effective and quality rich products.

Keywords: Caryota palm sago, underutilized, potential use, starch based food industry.

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Fish-Tail Palm, Jaggery Palm, Toddy Palm, Kittul tree, *Bankhajur*, *Mari* (Hindi), and *Jilugujattu* (Telugu).

Morphology and distribution

The lofty handsome palm with a smooth cylindrical annual trunk is fast growing up to 22 m in height and 2.8 m in diameter bearing large leaves, 5.4-6 m long and 3-3.6 m broad. The leaves are not grouped in a terminal crown as in case of the great majority of palms but spring successively from the trunk for a good distance below the summit. They are bipinnate with leaflets shaped like the tail of a fish. The palm grows rapidly by attaining its full height in 10-15 years, after which it begins to flower. It is monoecious. Flowers are borne on pendulous inflorescence, 3-3.6 m long appearing first at the axis of the leaves and later with advancing age continuing down wards till the palm is 20-25 years old, when it dies.



Caryota urens tree

Introduction

Starch is the major dietary component for all human populations. This biopolymer constitutes an excellent raw material for modifying food texture and consistency. Not only the amount of starch is important for the texture of a given food product but starch type is equally critical (Biliaderis, 1991).

Palms belong to one of the oldest families of plants on earth (Ishizuka *et al*, 1995) and are good source of food products and medicine. A lot of attention is currently being focused on the possibilities of exploring the less familiar plant resources existing in the wild. During the last decade, new findings on sago palm

which yields starch, yet an under used natural resource, have accumulated through the progress in the scientific research in various disciplines.

The three sago palms, *Caryota urens* Linn., *Metroxylon sagu* Rottb. and *Corypha umbraculifera* Linn. are currently considered as promising palms for the future (Madulid, 1990). *Caryota urens* is extensively dealt with here is said to have greater domestication potential or management potential (De Zoysa *et al*, 1992). It is a multipurpose tree species found in natural forests and home gardens in the wet and intermediate zones. Also cultivated for preparation of sago, toddy, jaggery and fibre (Wealth of India, 1992). The common names are



Kittul tree is considered to be indigenous to India, Sri Lanka and Malaysia. It is found in the moist forests of the western and eastern coasts and in the cool and shady valleys of Chota Nagpur, Orissa, West Bengal, and eastern India at altitudes ranging between 750-2,050 m. In Kerala, the palm is found in profusion. It is well adapted to wet and less wet climates.

The present day commercial production of palm sago occurs mainly in mainland and insular South-East Asia and Melanesia. There is currently a resurgence of interest in sago palm in South-East Asia, where small scale processing remains the predominant form of starch extraction (Oates, 1998).

Sago extraction

The main edible food product obtained from this palm is the starch stored in large quantities in its trunk. It is reported to be one of the cheapest and most readily available sources of food starch with the highest productivity per land area among other starch crops. The palm reported to generate 24 tonnes/hectare of starch per year, compared to rice (6 tonnes); corn (5.5 tonnes); and potato (2.5 tonnes) (Shoon Jang, 2000).

There are many ways of extraction of starch from the palm pith, but the principles and methods are said to be similar. Traditional step-wise extraction process followed by tribals of Andhra Pradesh includes—felling of the trees before flowering during rainy season when it is dormant, separating the bark from the pith by debarking the trunk with an axe, splitting /cutting the debarked log into small pieces of wood scrapings using

traditional rasper or axe, pounding the pieces to loosen starch particles, washing in water followed by sun drying the settled starch matter or suspension, sieving it through fine cloth to obtain fine starch (Rajyalakshmi, 1991; Anilakumai & Rajyalakshmi, 2000).

In large scale processing the sago logs are first debarked, followed by maceration using a rasper. Newer types of raspers have eliminated the need for debarking. The sago chips resulting from maceration process are further disintegrated using a hammer mill. The starch slurry is then passed through a series of centrifugal sieves to remove coarse fibres. Cyclone separators are used to extract the starch which is then dried using a rotary vacuum drier followed by hot air drying. There are currently 11 such modern sago-processing plants in Sarawak (Yiu-Long & Lim Eng-Tian, 1991).

The trunk of one tree yields around 100-300 kg pith from which starch is made. The variation in the yield of sago palm has been attributed to biophysical difference or differences in management

technique and as a result of differential skill and technology. The yield of sago is reported to be high from palms, which are cut before flowering and have not been tapped for toddy (Wealth of India, 1992).

Physico-chemical characteristics

The sago particles are reported to be oval and spherical with 44 µm size. Amylose content is 16g and with one step swelling between 70 and 75° C similar to tuber starches (Ahmed *et al*, 1999). Physico-chemical properties of sago as compared to other cereal/root starches are presented in Tables 1 and 2.

Chemical composition of Sago starch is not greatly influenced by the palm species, age, habitat or agronomic practices and the main variability in the chemical composition of the product originated from the processing system (Jackson *et al*, 1989).

Nutritive value of caryota palm as reported from various sources ranged as follow: moisture, 10-15; fat, 0.1-0.3; ash, 1.5-2.5; fibre, 0.2-3.5; carbohydrate,

Table 1 : Physico-chemical characteristics of Caryota palm pith flour and corn flour

Quality characteristics	Caryota palm pith flour	Corn flour
Moisture g%	6.7	10
Amylose g%	16.7	25
Total starch g%	64.0	71
Starch granule size, µm	44	15
Starch granule shape	Oval and spherical	Round and polygonal
Phenols mg%	52	Nil
Bulk density wt/vol	0.72	0.68

Table 2 : Properties of sago and other starches

Particulars	Origin of starch					
	Sago	Maize	Potato	Rice	Cassava	Wheat
Granule size (µm)	20-60	15	15-100	3-8	5-35	2-10
Granule shape	Oval	Round polygonal	Oval	Polygonal	Oval with indentation	Round
Amylose%	27	26	24	17	17	25
*Swelling power %	97	24	>1000	19	71	21
Initial pasting temperature °C	69	62	56	66	58	65

*Swelling is greatly influenced by phosphate ester usually presented in potato starch.

80-82; and starch 64 g%; it is said to be poor source of protein, fat and mineral matter (Rajyalakshmi & Geervani, 1994; Anilakumai & Rajyalakshmi, 2000).

Bleaching of Sago

One of the major problems leading to under utilization of crude caryota sago both at household level and industrial sector is its pinkish colour and astringent taste. The colour intensifies on wet cooking, making it less preferable for use in various food systems (Anilakumai & Rajyalakshmi, 2000).

Studies on *Metroxylon sagu* concluded that mechanical injury or physiological injury during sago extraction from logs cause browning due to interaction of polyphenols with polyphenoloxidase or the presence of catechin and epicatechin which may act as substrate for enzymatic browning (Onsa *et al*, 1998). Total polyphenol content in

crude sago is said to range from 52 to 63 mg% (Anilakumai & Rajyalakshmi, 2000). Polyphenolic compounds are closely related to sensory, nutritional and aesthetic quality of foods. They are said to contribute to colouring, bitterness, aroma and astringency. Bleaching by very light oxidation with sodium chlorite solution containing weak acetic acid is said to have



Bleached sago powder



Crude sago

little interaction with starch molecules with no change in the physical properties of starch or its solutions (Franson, 1997). It is reported that sodium chlorite is used in flour processing, as a decoloring agent for carotenoids and other natural pigments and as a bleaching agent in the preparation of modified food starch (Chemical Manufactures' Association, 1989; USDA, 1990).

Bleaching under alkaline condition is shown to reduce condensed tannins significantly which might be due to oxidative depolymerization of condensed tannins resulting in the formation of highly polymeric nutritionally and organoleptically inactive compounds (Beta *et al*, 2000).

Work done in the authors department revealed that bleaching of the sago using dilute sodium chlorite solution containing weak acetic acid significantly reduced phenolic constituents. The products prepared with bleached sago incorporating at 60 per cent level for both



Table 3 : Comparison of bleached Caryota sago with commercial sago specifications of Rabbit brand sago (Malaysia)

Composition (%)	Bleached caryota palm	Rabbit brand sago (<i>Metroxylon sagu</i> Rottb.)*
Moisture	15.40	11.15
Carbohydrate	81.61	80-84 Min
pH	7.0	6.0-7.0
Fibre	0.19	0.2 Max

*NeeSeng Ngeng (1984)

noodles and biscuits and 100 per cent level of incorporation for gel preparation were highly acceptable as compared to control. Specifications of bleached sago as compared with Rabbit brand sago (*Metroxylon sagu* Rottb) are given in Table 3 (NeeSeng Ngeng, 1984).

Uses in food systems

Though palm sago is reported to be equal in quality to the best sago of commerce obtained from *Metroxylon sagu* with excellent baking qualities and have greater production potential its use in food system has not been exploited to its full potential (Wealth of India, 1992).

Sago is reported to have great potential for its incorporation into foodstuffs such as noodles, sauces, dry mixes, flakes, snacks, and baby foods to



Caryota sago gel

replace more expensive starches which are imported (Suwanliwong, 1998). The noodles prepared for palm sago possess predominant characteristics that have been reported to define the quality of noodles, viz. appearance, and textural factors such as translucency, colour, uniformity of appearance, mechanical strength and integrity, absence of sticky surface and soft eating property (Sowbhagya & Zakiuddin Ali, 2001).

The sago was reported to act as thickener, gelling agent, fat replacer and crisp enhancer (Anilakumai & Rajyalakshmi, 2000). Compared to tuber starches sago starch is said to have higher pasting temperature (72-90°C), a higher ratio of amylose to amylopectin, and a much greater swelling power (97%) (Encyclopaedia of Food Science & Nutrition, 1993).

Incorporation of caryota palm sago at 60% level with refined flour in the preparation of biscuits is reported to decrease fat requirement by 8% and preferred textural quality as compared to control. Gel prepared with 100% sago is reported to yield a firm, tender, smooth and opaque gel without syneresis upon



Caryota sago biscuits

cooling of the gel. Paste characteristics of sago as compared to corn starch are given in Table 4 (Anilakumai & Rajyalakshmi, 2000).

Incorporation of sago at 35% level to potato starch said to yield noodles with less brittle, more elastic, firmer with lower cooking loss and less swelling power when cooked (Web ref. www.fsh.opm.edn.my/research/agro-induster/agri7html).

Traditional Uses

Caryota palm pith is a popular famine food in many parts of South India. In Andhra Pradesh the tribals store sago round the year in bags or pots for use in lean season. They prepare *roti* (pancake) or gruel (porridge) either solely with palm sago or in combination with ragi flour. For



Caryota sago noodles

Table 4 : Paste characteristics and gel quality of Caryota palm sago as compared to corn starch

Types of flour	Gelatinization temp. (°C)		Hot paste spread (cm)	Height before inverting (cm)	Height after inverting (cm)	% sag	Gel quality score
	Onset	Peak					
Caryota palm sago	73	75	5.2	3.0	3.0	0	5
Corn flour	76	95	4.8	3.0	3.0	0	4

Gel quality score: 5, very good; 4, good.

preparation of pancake, tribals use *adda* leaves (*Bauhinia vahlii* Wight & Arn.). The flattened dough is placed in between two *adda* leaves and cooked on both sides till the leaves become brown (Rajyalakshmi, 1991; Anilakumai & Rajyalakshmi, 2000).

In Malaysia also, sago starch is used in various traditional food products such as sago pearls, biscuits, noodles, and desserts (Jackson *et al*, 1989).

It has a long history in Sri Lanka of use where Hukura, a specific caste is said to make their living from kitul tapping, jaggery making and sago extraction, generating rural economy (Bandaratillake, 1994). It is said to be the second most important production activity next to agriculture by Dulong ethnic group in China (Long-Chunlin *et al*, 1999).

Industrial uses

Sago starch is used widely both in food and non-food industries. A full range of products as indicated in Table 5

are made totally or partially from sago starch (Jackson *et al*, 1989).

In Papua New Guinea, on a commercial scale it is used in the production of vermicelli and fish crackers (Jackson *et al*, 1989) and is reported to be used together with rice, corn and potatoes in the manufacture of noodles and white bread and in monosodium glutamate industry and the soft drink industry to make various syrups (Chew-Tek Ann *et al*, 1999).

Sago in the form of small whitish/pinkish, brownish grains is exported to

Europe and America where it is used mainly for thickening soups, making puddings and has great potential for its incorporation into various other food stuffs to replace more expensive starches which are imported (Suwanliwong, 1998).

Currently, Australian researchers are trying to genetically alter corn starch using gene from sago starch due to the unique property that it can be easily expanded. This property is particularly important in snack industry.

Conclusion

From the socio-economic and socio-cultural point of view caryota palm forms a part of the core of the South Indian ethnic group. Encouraging organized cultivation and exploitation of sago as a plantation crop may result in large-scale production of starch for the global industries and development of economy in the region.

There is a demand for innovation of technologies, exploitation of sago for commercial use and sustainable development of ethnic communities through directed research.

Table 5 : Uses of palm starch in food and non-food industries

Food industry	Biotechnological industry	Non-food industry
Confectionery	High fructose syrup	Biodegradable plastic
Sago pearl	Glucose syrup	Textile
Bread making	Dextrose monohydrate	Paper
Desserts	Caramel	Adhesive
Noodles	Maltose	Plywood
Crackers	Malto dextrins/sweeteners	
Modified starch	Monosodium glutamate	



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