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Characterization of Acid and Base Hydrolyzed Sago (*Metroxylon sagu)* Starch

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Abstract: This manuscript deals with gelatinization, modification and characterization of *Metroxylon sagu. Metroxylon sagu* polymer was purchased as crude material, gelatinized and further characterized in terms of organoleptic properties and micromeritic studies. The results showed that the gelatinized starch possess optimum organoleptic as well as micromeritic properties. The gelatinized starch was modified and four deferent batches were prepared F1-F4 and characterized. Bulk density and tapped density of F3 batch (0.76±0.03, 1±0.03) of sago starch were more than that of other batches. The lowest surface tension was found to be 65.88±0.89 of F1 batch. Viscosity of F4 batch (9.7±0.17) of sago starch was found to be highest among all the other batches.

Key words: Natural polymer · *Metroxylon sagu* · Sago starch · Gelatinization · Characterization

INTRODUCTION

Natural polymers are utilized in most of the preparation and are more propitious over synthetic polymers as they are economical, nontoxic, low cost, and easily available [1]. Natural polymers are biodegradable in nature they do not cause any pollution. Natural polymers have many pharmaceutical application such as, diluents, binder, disintegrant in tablets, thickness in oral liquid, protective colloids in suspension, gelling agents in gels and bases in suppository, they are also used in cosmetic, textiles, paints and paper making [2,3,4]. Starch or amylum is a naturally occurring, biodegradable, inexpensive and abundantly available polysaccharide molecule [5]. Starch is a carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. This polysaccharide is produced by all green plants as an energy store. It is the principal form of carbohydrate reserve in green plants and especially present in seed, stems, roots and fruits. The major sources of starch are maize (*Zea mays*), rice (*Oryza sativa*), wheat (*Tritium aestivum*), potato (*Salanum taberosum*), and sago (*Metroxylon sagu*) [6].

Metroxylon sagu (Family: Palmae) is the most common source of plam derived sago and is considered the true sago plam [7]. *Metroxylon sagu* is widely distributed in Southeast Asia such as in Thailand, Malaysia and Indonesia [8]. Sago starch is produced from the pith of the cycads of the genus, cycas. Cycas revolute which is referred to as sago plam, Japanese sago, or king sago and *Cycas rumphii* as tree sago or queen sago [4]. Sago starch is composed of 27% amylase and 73% amylopectin. It is a fine and white powder and used in cosmetic formulations. Sago starch is an excellent source of carbohydrates. Sago starch is used in Southeast Asia in the production of many different kinds of foods such as vermicelli, bread, crackers and biscuits [9]. Sago starch is commonly used as functional ingredient (e.g. thickeners, stabilizer, geling agent) in the food industry [10,11].

Gelatinization of sago starch: 10gm of sago starch was taken in 250ml beaker and boiled for 4-6hrs at a temperature of 40-50°C. Similarly three other batches were prepared. The first batch (F1) was added with 0.1N H_2SO_4 (1ml), second batch (F2) with 0.1 N HCl (1ml), third with (F3) 0.1N NaOH (1ml), and the fourth (F4) was taken blank. All the batches were made to precipitate using ethyl alcohol. Further these were filtered using muslin bag, dried at 40°C and then powdered [12].

Physicochemical Characterization of Sago Starch: Organoleptic properties of sago starch: As described by author elsewhere, the sago starch was characterized for organoleptic properties such as color, odor, and taste [12].

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Ph of Sago Starch: As described elsewhere, the sago starch was weighed and dissolved in water separately to get a 1% w/v solution. The pH of solution was determined using digital pH meter [12].

Swelling Index of Sago Starch: Swelling index of the powdered sago starch was calculated by weighing a butter paper of size 2x2cm^2 and then the butter paper was dipped in a petridish containing 15ml of water. 0.1gm of the powdered sample was kept in a butter paper placed in petridish and the swelling index was taken out at different interval i.e. 15, 30, 45, 60, 120, 240, 300 and 1440min and swelling index was calculated using equation1.

$$\text{Swelling Index} = \frac{\text{Initial weight- Final weight}}{\text{Initial weight}} \times 100 \quad (1)$$

Viscosity of Sago Starch: As described by author elsewhere, viscosity of 1% w/v solution of four batch of sago starch was measured using an Ostwald's viscometer [13].

Surface Tension of Sago Starch: As described by author elsewhere, surface tension of 1% w/v solution of four batches of sago starch was measured using a stalagmometer [13].

Evaluation of Micromeritic Properties and Flow Behavior: As described by authors in previous publications bulk density, tapped density, bulkiness, Carr's index, Hausener's ratio and angle of repose were measured [12].

Particle Size Analysis: As described by author elsewhere, the particle size of four batch of sago starch was determined using microscopy [13].

RESULTS AND DISCUSSION

The results of physicochemical characterization of modified sago starch are discussed here. The organoleptic properties of sago starch were observed and found to be acceptable. The colour of powdered starch was white and it was odourless and tasteless. Different parameters of sago starch were evaluated and are summarized in table 1.

The Ash content of second batch of sago starch was higher than the other batch.

The pH of 1% solution of F1 and F2 of sago starch were slightly acidic and F3 and F4 slightly alkaline.

Bulk density and Tapped density of F3 batch of sago starch were more than that of other batches. Carr's index, Hausner's ratio and bulkiness of F4 batch of sago starch were more than that of other batches. It showed a better compressibility. Angle of repose of F1 batch of sago starch was found. It showed a excellent flow property.

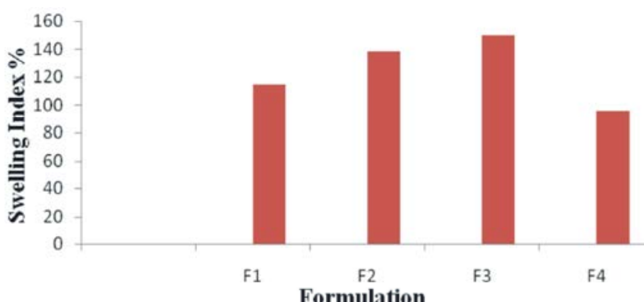

Fig. 1: Swelling index of sago starch

Table 1: Parameters of sago starch

Parameters	F1 (Acidify with H_2SO_4)	F2 (Acidify with HCl)	F3 (Alkaline with NaOH)	F4 (only water)
Ash value	6.46±0.50	9.43±0.51	5.23±0.25	7.41±0.52
pH	6.71±0.15	6.6±0.10	7.5±0.10	7.82±0.05
Bulk density (g/cm^3)	0.70±0.01	0.72±0.01	0.76±0.03	0.69±0.01
Tapped density (g/cm^3)	0.86±0.03	0.86±0.03	1±0.03	0.85±0.01
Bulkiness (cm^3/g)	1.43±0.03	1.38±0.02	1.30±0.05	1.44±0.04
Carr's index (%)	17.77±1.002	17.55±0.19	16.32±1.04	18.88±1.78
Hausner's ratio	1.09±0.24	1.21±0	0.96±0.01	1.23±0.02
Angle of repose (°)	1.44±0.27	1.113±0.20	1.282±0.22	1.118±0.15
Particle size (μm)	59.66±23.58	80.63±23.32	71.30±22.21	57.31±17.54
Surface tension (dyne/cm)	65.88±0.89	71.74±1.82	71.16±1.05	70.90±1.82
Viscosity (poise)	6.12±0.18	6.37±0.18	6.08±0.12	9.7±0.17

The F3 batch of sago starch had higher swelling power and fourth batch had bigger average granule size. The lowest surface tension was found to be of F1 batch of sago starch among all the other batches. Viscosity of F4 batch of sago starch was found to be highest among all the other batches.

CONCLUSION

It can be concluded that sago starch is an important excipient, because of its easy availability, less processing required, biodegradability and physicochemical properties can be successfully used in pharmaceutical industry. Sago starch has high swelling power, low gelatinization temperature. Particle size range of sago starch batches was found to be from 57.3-80.6μm. Bulk and tapped density of F3 batch of sago starch was more than that of other batches. All four batches of sago starch showed an excellent flow property and an optimum compressibility. The F1 batch of sago starch showed lowest Surface tension while the F4 batch showed highest viscosity amongst all the other batches.

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